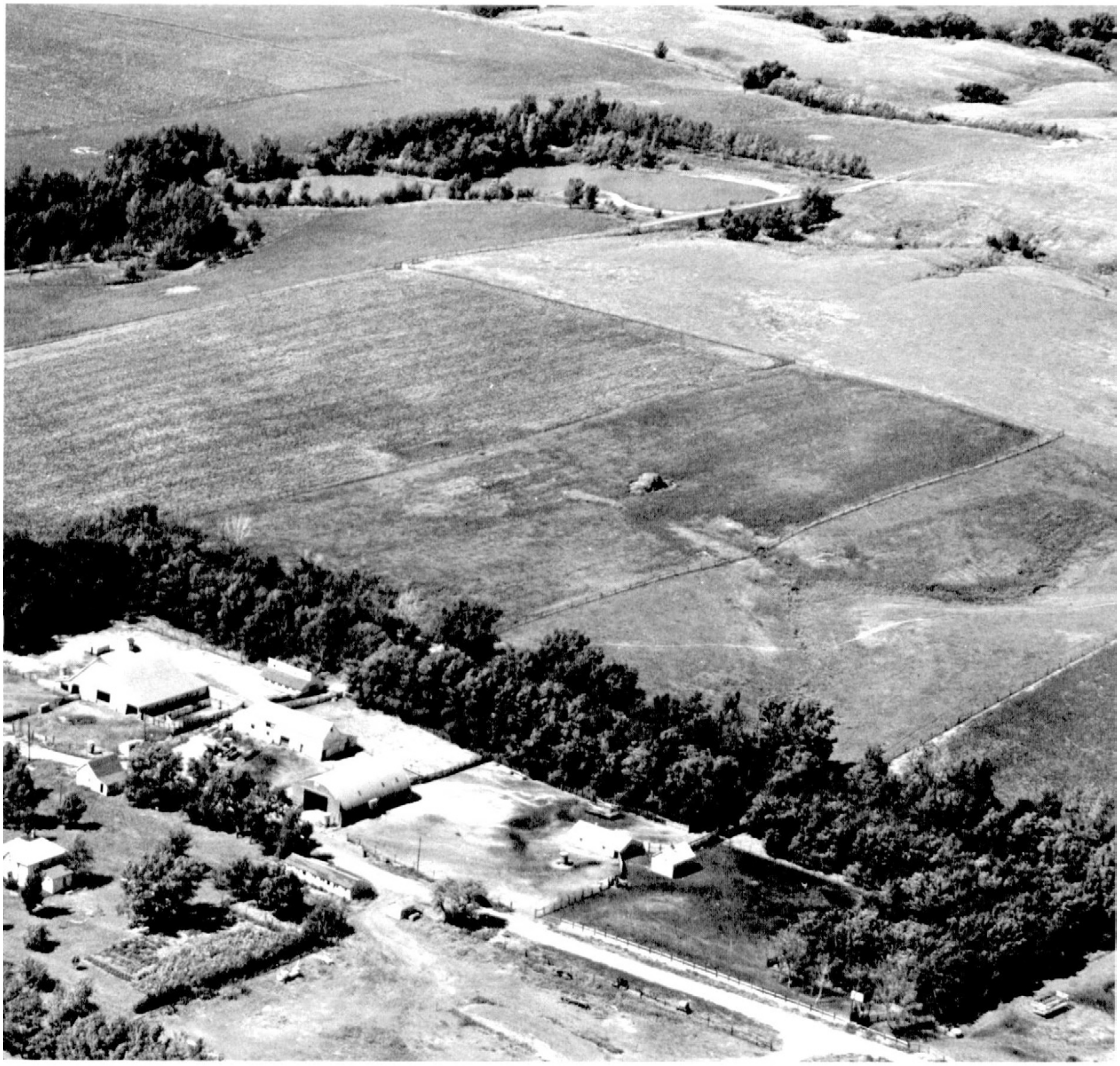
SOIL SURVEY OF

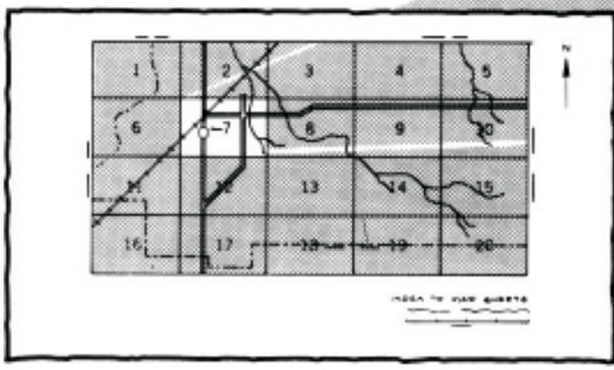
BOYD COUNTY, NEBRASKA

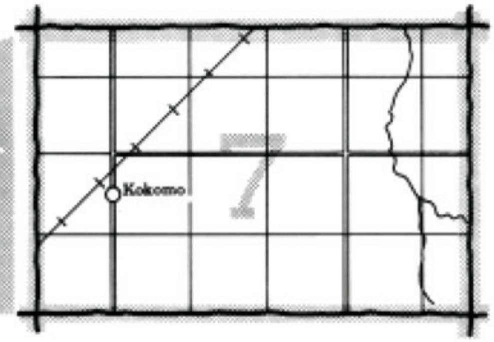


United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Nebraska Conservation and Survey Division

HOW TO USE

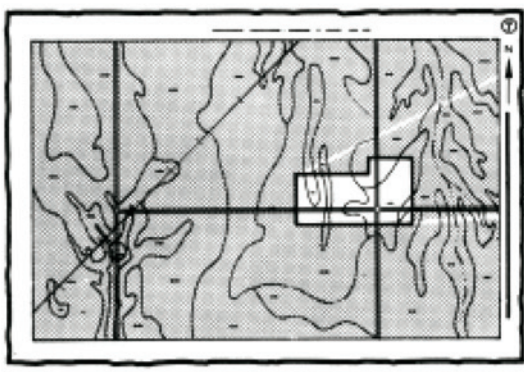
1. Locate your area of interest on the "Index to Map Sheets"

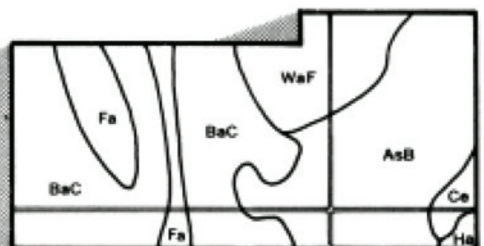




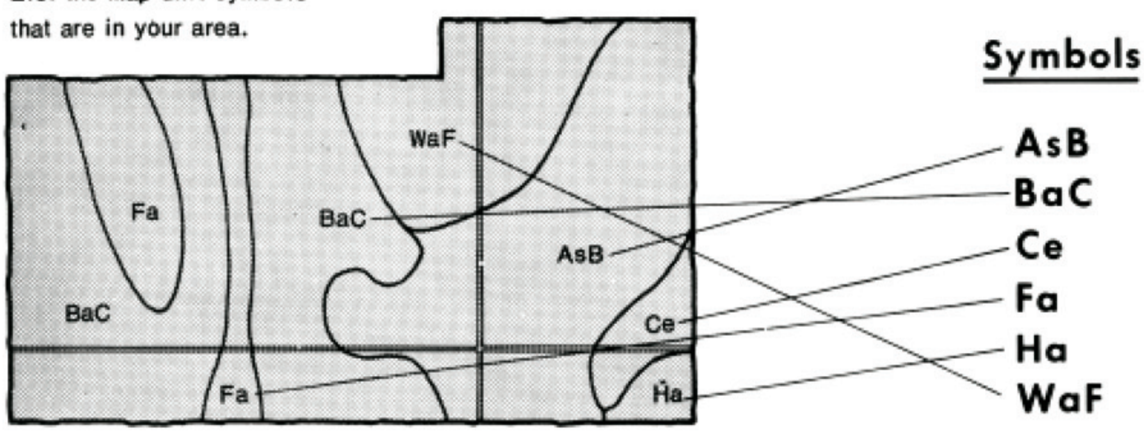
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



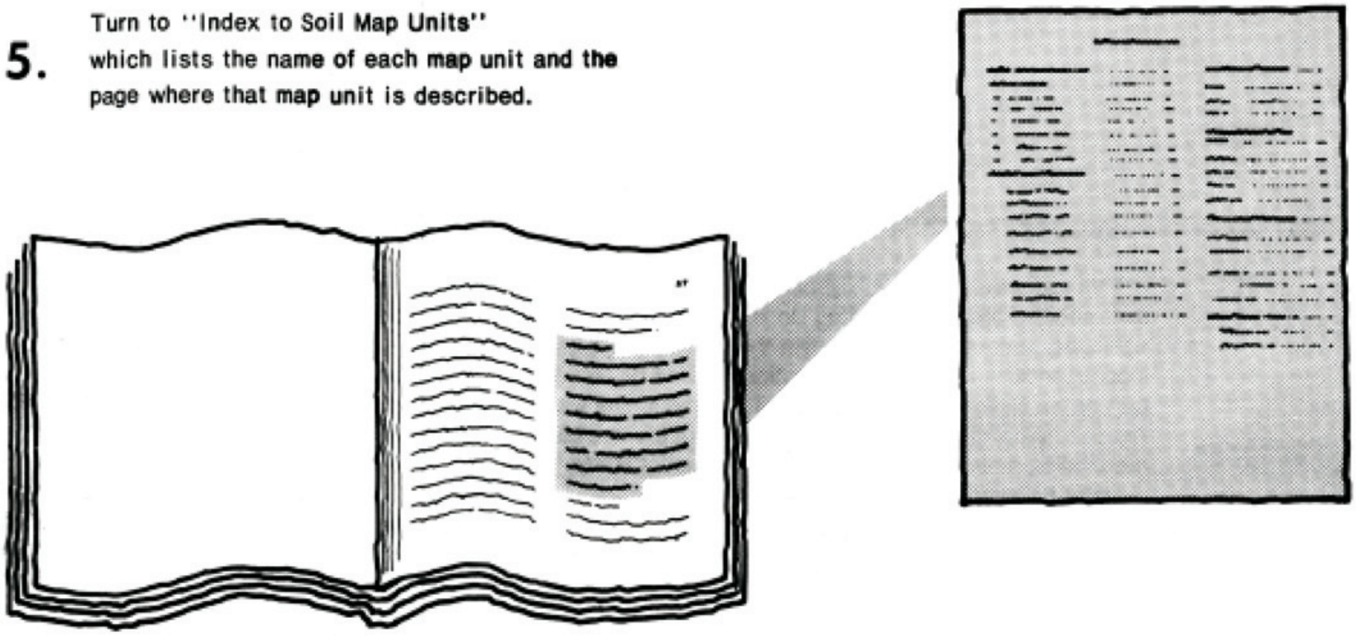


4. List the map unit symbols that are in your area.

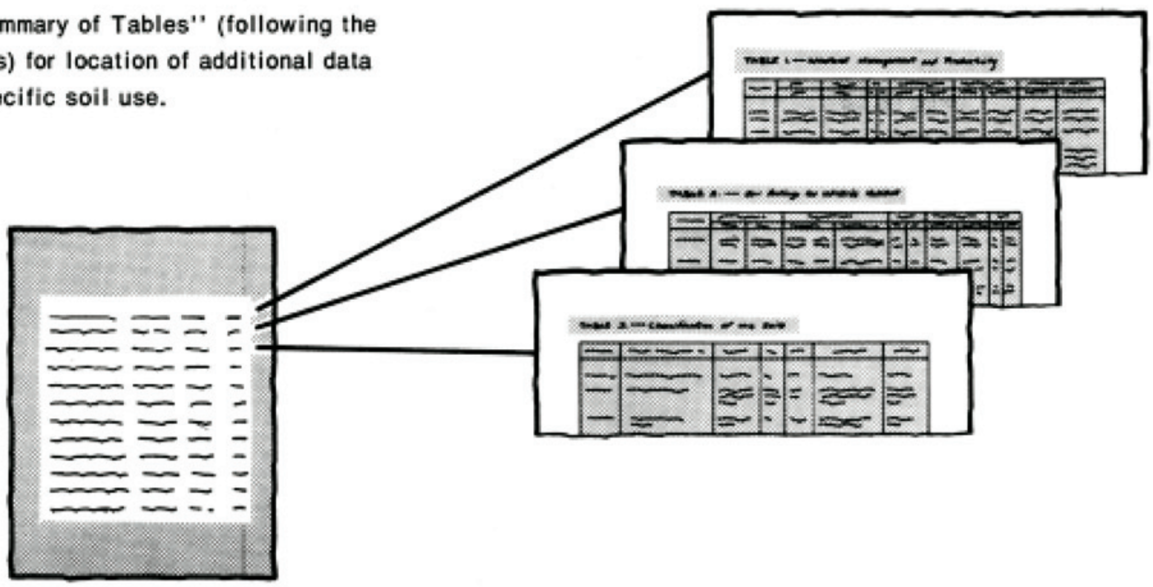


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and University of Nebraska Conservation and Survey Division. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1958-75. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Niobrara Natural Resource District. The Boyd County supervisors provided money to purchase the aerial photography.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Landscape of Onita-Reliance-Ree association in foreground and Labu-Sansarc association in background. Farmstead windbreaks, grassed waterways, and farm ponds are on the Onita-Reliance-Ree association.

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Issued March 1979

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Summary of Tables

Foreword

The Soil Survey of Boyd County, Nebraska, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations of hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

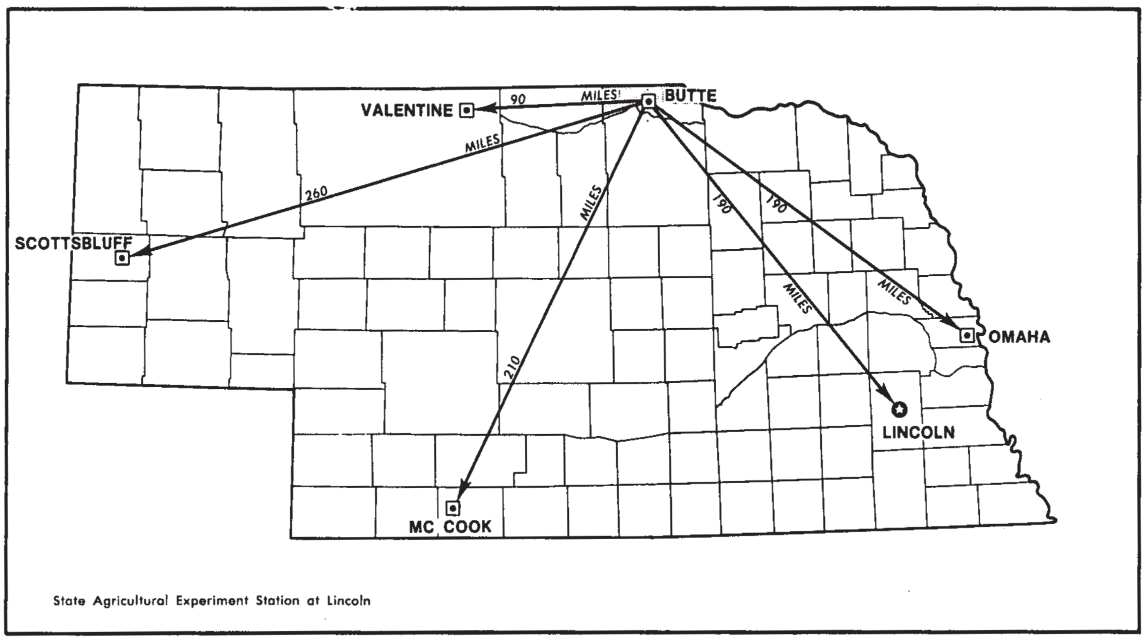
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential for the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Benny Martin
State Conservationist
Soil Conservation Service



Location of Boyd County in Nebraska.

Soil Survey of Boyd County, Nebraska

By Orville Indra, Soil Conservation Service
United States Department of Agriculture in cooperation with
University of Nebraska, Conservation and Survey Division

BOYD COUNTY is in the north-central part of Nebraska (see facing page). It adjoins South Dakota on the north and is bordered on the east by Knox County, on the south by Holt County, and on the west by Keya Paha County. The total area is 350,720 acres or 548 square miles. The total land area is 344,000 acres. Butte is the county seat, and Spencer is the largest town (*4*).

Farming is the chief enterprise in Boyd County. Most employment is in farming or related businesses. A few workers are employed by the few small industries in the county. Some residents drive to Atkinson in neighboring Holt County, where employment is available in an industry that manufactures irrigation systems. Corn, small grain, alfalfa, and grain sorghums are grown extensively on the more productive soils. These crops provide feed for cattle and hogs, as well as cash income. Agriculture has produced a stable economy in Boyd County.

Almost 90 percent of the soils in Boyd County are in the uplands. These soils are of two major types--the silty soils that formed in loess and the clayey soils that formed in shale. Less extensive soils formed in eolian sands and gravelly outwash material. Water erosion and soil blowing are the principal hazards on upland soils. The lack of sufficient rainfall to produce normal crops during some seasons is also a major concern. Conserving water through the prevention of runoff and maintaining fertility are the major concerns of management.

Soils in the valleys formed mainly in alluvial and colluvial material. Occasional flooding and wetness from the seasonal high water table are the principal hazards on soils of bottom lands. Maintaining fertility and good tilth and controlling soil blowing are the important concerns of management on these soils.

Most of the soils in Boyd County are silty or clayey. A few areas in the southwestern part and on bottom lands are sandy. The soils range from deep to shallow over mixed sand and gravel, bedded shale, and siltstone. They range from excessively drained to very poorly drained and from nearly level to very steep.

The first soil survey of Boyd County was made in 1937 (*3*). This survey updates the first survey by providing additional information and larger maps that show the soils in greater detail.

General nature of the county

This section provides general information on Boyd County. It discusses the history and development, the physiography, relief, and drainage, the geology, the climate, and the water supply.

History and development

One area that is now included in Boyd County was a part of the Dakota Territory annexed to Nebraska in 1882. The first permanent settlements were along the Keya Paha River in about 1880. This area, between Keya Paha and Niobrara Rivers, was known as Turtle Creek Precinct. It was part of Holt County and was settled before the rest of Boyd County (*4*). Boyd County was established and organized in 1891. Butte was the county seat. The rest of the land now included in Boyd County was part of the great Sioux Reservation and the Fort Randall Military Reservation. The Indian land was opened for settlement in 1889 when a treaty was signed between the United States Government and the Indians. The Military Reservation land was opened for settlement in 1893. The Turtle Creek Precinct was annexed to Boyd County in 1909. A large proportion of the early settlers were of German and Czech descent.

According to Federal census records, there were 605 inhabitants in Boyd County in 1890. The number increased rapidly and steadily until it reached a peak of 8,826 in 1910. Since that time there has been a continuing decline. In 1970, the population totaled 3,752. The population is classified as rural. The population is greater in the towns along the broader stream valleys and in the loess-covered parts of the uplands. The rough and broken areas, mainly the clayey soils along the Missouri, Niobrara, and Keya Paha Rivers, are sparsely settled.

Butte, the county seat, has a population of 575. Spencer, the largest town, has a population of 606. These towns,

about 10 miles apart, are centrally located in the county. Lynch, the next largest town of 375 inhabitants, is in the southeastern part of the county. Smaller towns and villages, including Naper, Bristow, Anoka, Monowi, and Gross, are located in different parts of the county. They provide local markets and distribution centers for farm supplies and produce.

A branch line of the Chicago and North Western Railroad from Norfolk, Nebraska, to Winner, South Dakota, following the valleys of Ponca and Dry Creeks through the county, serves all of the towns except Naper and Gross. U.S. Highway 281 crosses the county in a north to south direction, passing through Spencer, Nebraska. Nebraska Highway 11 crosses the county from north to south and passes through Butte. Nebraska Highway 12 extends across the county from east to west to all towns except Anoka and Gross. All but a few miles of the State and Federal highways are hard surfaced. Many of the county roads are gravelled. A few are hard surfaced and provide a good feeder network to the State and Federal highways. They follow the section lines except in the rougher parts of the county where they conform to topography. Bridges cross the Niobrara River south of Lynch, Spencer, Butte, and Naper. Rural mail routes reach all parts of the county. Telephone and rural electrification lines serve all rural areas.

Public schools ranging from elementary grades through high school are located in Naper, Butte, Spencer, and Lynch. Two rural elementary schools are still serving rural areas.

Several agribusinesses in the county sell fertilizer and process feed for livestock. Many sell and service farm machinery.

Cattle, including feeders, and hogs are shipped to Sioux City and Omaha for market. Dairy and poultry products are marketed both locally and outside the county. Grain and feed products not used on the farm are sold at local elevators and then shipped to other markets.

Farming has been the main enterprise in Boyd County since it was settled. In recent years, trends in land use have changed, but the agricultural economy continues to grow. The 1968 Nebraska Agricultural Statistics listed 570 farms in Boyd County. In 1974, the number was reduced to 530. Almost all of this reduction is the result of an increase in the size of farms, not urban expansion or industrialization.

The irrigated acreage increased from 246 acres in 1964 to 1,820 acres in 1970 and 3,500 acres in 1975. In 1964, 1,048 tons of commercial fertilizers was sold, compared with 1,818 tons in 1974.

Corn is the main cultivated crop in the county. The acreage of dryland corn harvested for grain increased from 27,144 acres in 1964 to 29,500 acres in 1974. The acreage of grain sorghums decreased from 29,244 acres in 1964 to 12,800 acres in 1975. The acreage of dryland oats increased from 13,324 in 1964 to 17,900 acres in 1975. The acreage of wheat and soybeans has increased in recent years. The acreage of alfalfa and tame grasses has increased only slightly.

The total number of cattle in the county increased from 47,268 in 1964 to 51,700 in 1975. Dairy cattle decreased from 2,602 in 1964 to 1,440 in 1975. The number of hogs has fluctuated each year, but the average number during the 10-year period has remained fairly constant. The number of poultry and sheep has decreased in recent years.

Physiography, relief, and drainage

Boyd County is in the high plains section of the Great Plains physiographic province. Four general landforms constitute the present topography and relief of the county -- a high plain, an intermediate plain, steep hills and escarpments, and stream valleys. These landforms are the remnants of a former nearly level to hilly constructional plain, which was subsequently eroded by the Missouri and Niobrara Rivers and their tributaries.

The land surface in the northwestern part of the county is a high plain remnant that has not been significantly modified by erosion. It is capped by a deposit of sand and gravel. Other outlying remnants of the high plain are the Twin Buttes between Naper and Butte, the Harvey Buttes south of Butte, Ninemile Hill northwest of Gross, and the east-west ridge 6 miles north of Spencer.

A gently rolling intermediate plain, 100 to 200 feet lower than the high plain, occupies an intermediate position between the high plain and the modern stream valleys. It forms the upland areas between the major streams, except in the eastern part of the county. The intermediate plain consists generally of the remnants of consolidated rocks that underlie the high plain before erosion and the younger sediments that overlie the rock remnants. These sediments consist of stream-deposited sands and gravels, and wind-deposited sands, silts, and clays. The stream-deposited sediments are the thickest where they fill a former valley on the south side of the Keya Paha River. Remnants also occur on high terraces on either side of Ponca Creek. The wind-deposited sediments are generally thin and mantle the intermediate plain much more extensively than the stream-deposited sediments.

The relief differential between the intermediate plain and the adjacent stream bottoms varies considerably in different parts of the county. The intermediate plain between the Keya Paha River and Niobrara River is 100 to 200 feet higher than the flood plains of those rivers. The intermediate plain between the Keya Paha River and Ponca Creek is about 250 feet higher than the river flood plain but only 200 feet higher than the flood plain of the creek. In the central and eastern parts of the county, the intermediate plain is 200 to 300 feet higher than the flood plain of the Niobrara and 100 to 200 feet higher than the flood plain of Ponca Creek. The intermediate plain between Ponca Creek and the Missouri River is about 500 feet higher than the flood plain of the Missouri.

After the intermediate plain had developed, a lowering of the base level caused streams to deepen their valleys,

thus producing rugged escarpments and steeply eroded hills along the valley sides. This landform consists almost entirely of remnants of underlying rock formations. Relief is more than 200 feet per quarter mile along the Missouri and Niobrara Rivers. Stream valleys in Boyd County are narrow compared with those of most other Nebraska streams. About 10 percent of the total area of the county is in stream valleys.

Boyd County is drained by three major drainage basins. The northeastern part, which is about 11 percent of the county, drains directly into the Missouri River. A narrow band along the southern part drains directly into the Niobrara River. Much of the western part of the county drains into the Keya Paha River, a tributary to the Niobrara. These two rivers together drain about 27 percent of the county. The large remaining area, about 62 percent of the county, drains to Ponca Creek, which heads in South Dakota and flows southeasterly and easterly across Boyd County to enter the Missouri River in northwestern Knox County.

The Niobrara and Keya Paha Rivers derive much of their flow from tributaries that are fed by ground water seepage in their upper reaches. Therefore, they have a fairly constant flow.

The flow of Ponca Creek is derived almost entirely from overland runoff and very little from underground seepage. Much of the drainage area consists of exposed Pierre Shale, which has rapid runoff because of steep slopes and a slow absorption rate because of the fine texture. For these reasons, the flow is highly variable and the stream goes dry in most summers.

The flow of the Missouri River, where it borders Boyd County, is controlled by releases at the Fort Randall Dam.

All of the uplands are reached by the drainage basins of one of the major streams. Those areas of the uplands that are mostly sandy or silty and are moderately to rapidly permeable do not contribute significant amounts of direct overland runoff to streams. Some of the water that does run off is discharged into shallow upland depressions. Some also is retained in small stock ponds around the upland margin. Areas that contribute most of the runoff that reaches the principal streams are the exposures of Pierre Shale where the steep slopes are too fine textured and compact to absorb moisture readily (*5*).

Geology

Outcropping rock units in Boyd County are of Late Cretaceous, Tertiary, and Quaternary age.

Exposed Late Cretaceous rock units in Boyd County are the Niobrara Formation and the Pierre Shale. The Niobrara, the older of the two, is composed of chalk, calcareous shale, shaly limestone, and limestone. It crops out near the base of the Missouri River valley side. The exposures are vertical or nearly vertical. There is no soil material or plant cover. The Pierre Shale, which overlies the Niobrara, is composed of bentonitic shale, calcareous shale, shaly chalk, and claystone. It is exposed on the side slopes of most stream valleys and in many places in the upland where it is only thinly mantled with unconsolidated younger material. In some places the Mobridge Member of the Pierre Shale contains enough selenium that some grasses and cultivated crops take up that element from the soils. Animals that are fed this forage or grain may be affected by selenium poisoning. Water from wells or springs in these areas often contains more selenium than the recommended limit for drinking water.

Rock units of Tertiary age overlie the Pierre Shale throughout much of the upland. The lower of these, referred to by Souders (1976) as Miocene silt beds, occurs throughout the northeast, south-central, and western parts of the county. It has a maximum known thickness of 79 feet where it is protected from erosion by the overlying Ogallala Formation, but in most places it is less than 35 feet thick. The Ogallala Formation underlies the high upland plain at the northwest corner of the county and a few of the scattered buttes and high hills that are outliers of that high plain. It consists mostly of beds of fine sand and fine-grained sandstone but includes beds of clay, silt, and medium- to coarse-grained sandstone. The known thickness of the Ogallala Formation ranges from 70 to 160 feet beneath the high plain and from 30 to 70 feet beneath the outlying buttes and hills.

Unconsolidated deposits of Quaternary age occur throughout much of the upland, mantling the Pierre Shale, the Miocene silt beds, and the Ogallala Formation. They also occur as alluvial fill in all valleys and on terrace remnants along valley sides. In the upland these deposits are mostly eolian silt and fine sand. Sand and gravel fill the valleys of some ancient streams. In the small valleys, terraces and bottomland deposits are mostly fine-textured alluvium but may include layers of medium to coarse sand. The alluvial sediments in the valleys of the larger streams are dominantly fine sand and very fine sand with beds of silt and clay and in spots coarse sand and gravel.

Climate

Furnished by the climatology office, Conservation and Survey Division, University of Nebraska.

Boyd County, located in north-central Nebraska and bordered on the north by South Dakota, has a continental climate with light rainfall, cold winters, warm summers, and frequent changes in weather conditions.

About 77 percent of the annual precipitation occurs during April through September (see table 1). Most of the precipitation that falls in this area is carried in on warm, moist winds from the Gulf of Mexico or from the Caribbean Sea. In 68 years of record at Butte, precipitation in the driest year, 1910, was 12.48 inches and in the wettest year, 1915 was 40.14 inches.

The weather is variable early in spring, alternating frequently between periods of warm humid days and cold dry days. The changes gradually diminish in frequency and severity as spring advances. Early in spring much of

the precipitation falls as snow but gradually changes to slow, steady rain. Snowfall is heavier in March than in any other month. By mid-May most of the precipitation falls during showers and thunderstorms, increasing in amount throughout the spring. By early or mid-June the amount of precipitation begins to decrease.

In the latter part of August there are occasional outbreaks of cool air from the north, which become increasingly frequent during the fall. Sunshine is usually abundant in September and October, but cloudiness increases in November and December.

Precipitation in winter usually falls as light snow. When a deep storm center passes to the south and southeast of the county and is combined with an outbreak of cold air from the north, blizzard conditions may occur. Strong winds usually pile the snow in drifts. The extremely cold air following a blizzard usually remains over the area only a short time before it is replaced by warmer air from the west.

All data in table 1 are from records kept at Butte, Nebraska. Data in columns 1, 2, 5, 8, and 9 are based on the period of record 1945-74. Data in columns 3 and 4 are computer study based on the period 1948-63. Data in columns 6 and 7 are based on the period 1907-74.

Temperature records at Butte, from 1908, show the highest reading ever recorded was 115 degrees on July 20 and 21, 1934; July 17, 1936; and July 24, 1940. The lowest ever recorded at Butte was 36 degrees below zero on January 12, 1912.

The average date of the last 32-degree air temperature in spring is May 8. The average date of the first 32-degree air temperature in fall is October 1 (see table 2). All freeze data are based on temperatures which are measured in a standard National Weather Service thermometer shelter. The thermometers are placed approximately 5 feet above the ground. The exposure is believed representative of the surrounding area. Temperatures are lower nearer the ground and in local areas subject to extreme air drainage on calm nights.

Local topography has little effect on average temperatures over a long period. Long-term average temperatures recorded on flatland, for example, do not differ greatly from those recorded in the immediate area on rolling hills or in valleys. Records based on dates when specific temperatures were reached, however, may differ markedly over short distances.

If freeze data are to be used, dates should be adjusted to fit the particular exposure. Less exposed areas will have the last spring freeze at an earlier date and the first fall freeze at a later date.

Annual evaporation from the free surface of the water in small lakes and farm ponds averages 40 inches. About 78 percent of that amount occurs from May through October.

Water supply

Ground water supplies in Boyd County are limited because of geologic conditions unfavorable to the accumulation and storage of water. In past years most wells developed in the county were for domestic and livestock use. In very recent years some wells have been developed for irrigation.

Two major sources of water are available in the county. Water-bearing rock sediments above the Pierre Shale are shallow aquifers and can be reached with shallow wells. Those rock sediments below the Pierre Shale are deep aquifers and require deep wells.

The shallow aquifers consist of rock formations of Tertiary age (5). Also included with the shallow aquifers are the unconsolidated deposits that mantle much of the upland area of the county and underlie the low terraces and bottom lands in the principal stream valleys.

The tertiary silt beds occur in the uplands throughout the northeast, south central, and western parts of the county. They consist mostly of compact silt interlaced with thin layers of clay and sand. They contain only a thin zone of saturation over most of the county. Well yields are generally less than 3 gallons per minute but as much as 20 gallons per minute in some places. An exception is in the northwestern part of the county where these beds are fully saturated and contribute significantly to the yields of wells that also tap the Ogallala Formation. Some wells yield up to 300 gallons per minute in the highly saturated zones that are more than 175 feet thick. Smaller yields can be expected where the saturated zone is thinner. Generally the water quality from these formations is satisfactory for domestic and livestock use.

Quaternary sediments consist of clay, silt, sand, and gravel deposited by streams and wind. They mantle most of the upland area of the county except for the steep hills and escarpments that border the stream valleys. These sediments are important sources of water in some areas. The highest water yields are obtained from the relatively thick Quaternary deposits in the old valley fill of the intermediate plain between the Keya Paha and the Niobrara Rivers. Well yields averaging 600 gallons per minute and a few of more than 1,000 gallons per minute are obtainable. Other areas of relatively thick Quaternary deposits underlie high terraces along Ponca Creek. Well yields ranging from a few to possibly 200 gallons per minute are obtainable. The relatively thick Quaternary deposits that underlie the low terraces and bottom lands in the principal stream valleys have potential yields of generally less than 100 gallons per minute. In some places the Niobrara River Valley has a higher potential yield.

Throughout much of the upland area, shallow aquifers are thin to very thin and are capable of yielding between 1 and about 20 gallons per minute. The amount of available yield in any given well is extremely variable and can change within short distances, mainly because the saturated sediments are thicker where they fill low places over the underlying Pierre Shale. For this reason, test

drilling is necessary to locate the areas of thickest saturation. The thickness of the saturated alluvium in valleys also differs within short distances because bedrock trenches can occur at varying depths in different parts of the valley floor.

A considerable area of Boyd County has little or no ground water supply available from shallow aquifers. In these areas it is necessary to utilize aquifers beneath the Pierre Shale.

The Dakota Group, in the Cretaceous System, is the only water-yielding rock that underlies the entire county. This formation ranges from 450 to 750 feet thick. It consists mainly of sandstone and interbedded layers of siltstone, clay, and shale. The sandstones are the water-bearing layers. Because these sandstones lie between relatively impermeable rock strata, the confined water is under pressure and rises in wells to a level higher than that encountered in drilling. In lower areas in the eastern part of Boyd County, water flows from wells drilled into the Dakota Group. Depth to the Dakota Sandstone ranges from about 600 feet in the Missouri River Valley to more than 1,200 feet in the highest upland areas of the western part of the county. Water from the Dakota is highly mineralized and hard. It is not suitable for human consumption or for ordinary household uses, but it is tolerated by cattle. It is not suitable for irrigation. Yields of the few wells tapping the Dakota range from a few to 150 gallons per minute and larger yields probably could be obtained in many places.

The other water-bearing rock formation beneath the Pierre Shale is the Codell Sandstone Member of the Carlile Shale which is also in the Cretaceous System. It underlies only the eastern part of Boyd County. It is 0 to 60 feet thick and consists mostly of sandstone interbedded with siltstone. Depth to this formation ranges from about 200 feet below the Missouri River Valley to more than 600 feet beneath the uplands. Water in the Codell is also under pressure but does not flow at the surface anywhere in the county. Although fairly high in dissolved solids, the water is soft and is of much better quality than water from the Dakota. Wells generally yield less than 25 gallons per minute, but yields up to 50 gallons per minute probably can be obtained in some places. Wells drilled in this formation are an important source of stock water in the eastern part of Boyd County.

Surface water for irrigation is limited in Boyd County. The surface flow in Ponca Creek is not dependable, and waterflow ceases during the summer months of most years. The Keya Paha River provides a source of irrigation water for a few individual tracts of land in Boyd County. In recent years, pumping pressure from upstream irrigation has limited the water flow in this river also. The Niobrara and Missouri Rivers have a dependable waterflow, but the acreage of irrigable land is limited by the narrow stream valleys (*5*).

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land-use planning

The general soil map at the back of this publication shows, in color, map units, or associations, that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Silty soils on uplands

Two associations in this county consist of nearly level to moderately steep, well drained and moderately well drained silty soils.

1. Onita-Reliance-Ree association

Deep, nearly level to strongly sloping, well drained and moderately well drained silty soils formed in loess

This association consists of nearly level to strongly sloping broad plains, ridgetops, and upper side slopes of the thinly mantled loess areas that are divides between major drainageways in the county (fig. 1).

This association makes up about 29 percent of the county. It is about 36 percent Onita soils, 21 percent Reliance soils, 15 percent Ree soils, and 28 percent minor soils.

Onita soils are nearly level. They are in slightly concave swales and on broad upland divides. They are deep and well drained and moderately well drained. Permeability is moderately slow. Typically the surface layer is friable silt loam about 18 inches thick. The subsoil is about 20 inches thick. It is friable silty clay loam in the upper part, firm silty clay loam in the middle part, and firm silt loam in the lower part. The underlying material to a depth of 60 inches is lighter colored silt loam and loam.

Reliance soils are gently sloping to strongly sloping. They occur on convex ridgetops and side slopes. They are deep and well drained. Permeability is moderately slow. Typically the surface layer is friable silt loam about 10 inches thick. The subsoil is about 24 inches thick. It is friable silty clay loam in the upper part and firm silty clay loam in the lower part. The underlying material to a depth of 60 inches is lighter colored silt loam and fine sandy loam.

Ree soils are gently sloping to strongly sloping. They occupy positions similar to those of Reliance soils. Typically the surface layer is friable silt loam about 7 inches thick. The subsoil is about 15 inches thick. It is firm silty clay loam in the upper part and friable light clay loam in the lower part. The underlying material extends to a depth of 60 inches or more. It is sandy loam in the upper part and loamy fine sand in the lower part.

Minor in this association are mainly the Anselmo, Labu, Paka, and Scott soils. The fine sandy loam Anselmo soils are on knolls and ridgetops. The clayey Labu soils are on side slopes. Paka soils, which formed in material weathered from siltstone, are generally lower on the landscape than the major soils. The very poorly drained Scott soils are in shallow depressions.

Most of this association is in cultivated crops. A few small areas remain in rangeland. The potential is good for the commonly grown dryland cultivated crops, for pasture, and for trees and shrubs. The potential is good for irrigated crops, but the supply of water for irrigation is limited. The potential is fair for rangeland. It is good or fair for openland wildlife habitat and recreational use. It is fair to poor for most engineering uses.

Farms on this association are diversified, mainly cash grain and livestock enterprises. Corn, grain sorghum, small grain, and alfalfa are the main crops. Most pastures are small. They are mainly on the steeper Ree and Labu soils and on the very poorly drained Scott soils. Cattle that are fattened on farms are generally purchased as feeder calves. Hogs are commonly produced on the farms and fattened for market. Wells for livestock and domestic use are difficult to obtain on some farms.

Water erosion is a hazard on the sloping soils. Lack of sufficient rainfall is the principal limitation to crop production. Controlling erosion, conserving moisture, and maintaining fertility are the main concerns of management.

Farms on this association average about 320 acres. Gravel or improved dirt roads are along most section lines. U.S. Highway 281 and Nebraska Highway 12 cross part of this association. Farm produce is generally marketed at local markets, elevators, or auctions, or at larger terminals in Omaha and in Sioux City, Iowa.

2. Nora-Crofton-Eltree association

Deep, nearly level to moderately steep, well drained silty soils formed in loess

This association consists of nearly level to moderately steep soils on ridgetops and side slopes of uplands. These soils formed in recent limy loess material blown from the Missouri River Valley (fig. 2).

This association makes up about 5 percent of the county. It is about 29 percent Nora soils, 16 percent Crofton soils, 12 percent Eltree soils, and 43 percent minor soils.

Nora soils are gently sloping to strongly sloping. They occupy the upper side slopes. They are deep and well drained. Permeability is moderate. Typically the surface layer is very friable silt loam about 7 inches thick. The subsoil is about 27 inches thick. It is friable silt loam with a few dispersed lime accumulations in the upper part and friable, calcareous silt loam with common soft lime accumulations in the lower part. The underlying material to a depth of 60 inches is lighter colored silt loam. Nora soils are calcareous below a depth of about 15 inches.

Crofton soils are moderately steep. They occupy side slopes that border intermittent drainageways. They are generally lower on the landscape than Nora soils (fig. 3). They are deep, well drained, and eroded. Permeability is moderate. Typically the surface layer is friable silt loam about 6 inches thick. The transition layer is friable silt loam about 8 inches thick. The underlying material to a depth of 60 inches is lighter colored silt loam. Crofton soils are calcareous throughout the profile.

Eltree soils are nearly level. They generally are above the Crofton and Nora soils. They are deep and well drained. Permeability is moderate. Typically the surface layer is very friable silt loam about 25 inches thick. The subsoil is friable silt loam about 13 inches thick. The underlying material to a depth of 60 inches is lighter colored silt loam.

Minor in this association are the silty Paka, Onita, and Ree soils and the clayey Bristow, Labu, Lynch, and Sansarc soils. Onita soils are in slightly concave swales. The gently sloping to moderately steep Ree and Paka soils are on the upper hillsides. Bristow, Labu, Lynch, and Sansarc soils are on the lower side slopes of entrenched drainageways.

This association is used mainly for cultivated crops. Some of the steeper and more isolated tracts remain in rangeland. The potential is good for the commonly grown cultivated crops and for pasture and trees and shrubs. The potential is fair to good for irrigated crops, but the supply of water for irrigation is limited. The potential is fair for rangeland. It is good for openland wildlife habitat and recreational use. It is fair to good for building sites and roads and most engineering uses.

Farms on this association generally include areas of other associations that have soils more favorable for rangeland. As a result, they tend to be diversified, mainly livestock and cash grain enterprises. Corn, grain sorghum, small grain, and alfalfa are the main crops. Most pastures are small and are on the steeper Crofton soils. Cattle and hogs are commonly produced on the farms and fattened for market. Wells for livestock and domestic use are difficult to obtain on some farms and poor quality water is common.

Water erosion is a hazard on sloping soils. Erosion control and the maintenance of adequate fertility are the main concerns of management (fig. 4). Insufficient rainfall is the principal limitation to crop production.

Farms on this association average about 480 acres. Gravel or improved dirt roads are along most section lines. No national or state highways cross this association, but all areas included in the association are within 6 miles of either U.S. Highway 281 or Nebraska Highway 12. Farm produce is generally marketed at local markets, elevators, or auctions, or at larger terminals in Omaha and in Sioux City, Iowa.

Clayey soils on uplands

Two associations in this county consist of gently sloping to very steep, well drained and excessively drained clayey soils.

3. Labu-Sansarc association

Moderately deep and shallow, strongly sloping to very steep, well drained clayey soils formed in residuum from shale

This association consists of strongly sloping to very steep clayey soils that formed in residuum from shale. These soils occur as broad and narrow, deeply dissected areas on the valley sides and adjacent uplands along all of the major drainageways and many of the minor drainageways. The landscape is one of ridges, side slopes, and narrow valleys (fig. 5).

This association makes up about 24 percent of the county. It is about 43 percent Labu soils, 22 percent Sansarc soils, and 35 percent minor soils.

Labu soils are strongly sloping to steep. They are on the lower foot slopes and the smooth more rounded knolls of hillsides (fig. 6). They are moderately deep and well drained. Permeability is slow. Typically the surface layer is firm silty clay about 6 inches thick. The subsoil is about 19 inches thick. The upper part is firm silty clay, and the lower part is very firm silty clay. The underlying material to about 34 inches is lighter colored shaly clay and to about 60 inches bedded shale.

Sansarc soils are steep to very steep. They occur generally on the higher and steeper side slopes. They are shallow and well drained. Permeability is slow. Typically the surface layer is friable silty clay about 5 inches thick. There is a transition layer about 11 inches thick. The upper part is very firm shaly clay, and the lower part is extremely firm shaly clay. The underlying bedded shale extends to a depth of 60 inches. Shale fragments are common throughout the soil.

Minor in this association are mainly the Boyd, Mariaville, Paka, Promise, and Reliance soils. Boyd soils have a thicker surface layer than Labu soils but occur in similar positions. The deep Paka soils and the shallow Mariaville soils, both of which formed in material weathered from siltstone, occur on the upper slopes above Labu and Sansarc soils. The silty Reliance soils, which formed in loess, occupy the highest part of the landscape. The deep clayey Promise soils are below the Labu soils, on colluvial foot slopes and fans.

Most of this association is native rangeland. Some of the less sloping areas are used for cultivated crops and

hay. The potential is fair to poor for rangeland. The potential for cultivated crops is generally poor. On the lower slopes, it is fair. The potential is poor to very poor for windbreak plantings and for openland wildlife habitat. It is fair for rangeland wildlife habitat and poor for most recreational and engineering uses.

Farms and ranches on this assciation generally include areas from other associations that have soils more favorable for cultivation. For this reason, farms tend to be diversified, mainly livestock and cash grain enterprises. A few large ranch units produce feeder calves for market.

Grass production is limited by the low rainfall. Except in areas served by pipelines, water for livestock is limited to the precipitation caught and stored in stock water ponds. Wells within the area are deep but yield small amounts of highly mineralized water, which may not be suitable for domestic use. The potential for irrigation development is poor because of the clayey soils, the excessive slopes, and the lack of water.

Proper range use and a vigorous stand of grass are concerns in range management. Providing an adequate water supply for livestock is also a major concern.

Farms and ranches on this association average about 1,400 acres. Some gravel or improved dirt roads cross this association but generally do not follow section lines. Feeder cattle are produced and fed on local farms and are marketed at local livestock markets or at large terminals in Omaha and in Sioux City, Iowa.

4. Bristow-Lynch association

Shallow and moderately deep, gently sloping to very steep, well drained and excessively drained clayey soils formed in residuum from calcareous and gypsiferous chalky shale

This association consists of gently sloping to very steep, calcareous clayey soils that formed in light colored chalky shale. These soils occur on ridges and side slopes and in narrow valleys, generally below the dark shale (fig. 7).

This association makes up about 16 percent of the county. It is about 35 percent Bristow soils, 27 percent Lynch soils, and 38 percent minor soils.

Bristow soils are limy. They occur on the steep side slopes, higher on the landscape than Lynch soils. They are shallow and well drained and excessively drained. Permeability is slow. Typically the surface is friable silty clay about 7 inches thick. The subsoil is about 10 inches of shaly clay. The underlying material to a depth of 60 inches is bedded shale.

Lynch soils are gently sloping to steep. They are generally lower on the landscape than Bristow soils. They are moderately deep and well drained. Permeability is slow. Typically the surface layer is about 8 inches thick. The upper part is friable silty clay, and the lower part is firm silty clay. The subsoil is about 20 inches thick. It is firm silty clay in the upper part and very firm silty clay in the lower part. The underlying material is lighter colored. To a depth of 33 inches it is silty clay loam, and to 60 inches bedded shale.

Minor in this association are mainly Anselmo, Crofton, Grigston, Nora, Labu, and Sansarc soils. The loamy Anselmo soils and silty Crofton and Nora soils are at a higher elevation than the major soils in this association. The clayey Labu and Sansarc soils, also generally at a higher elevation, formed in the darker shales. The silty Grigston soils are on narrow bottom lands along drainageways and are subject to flooding.

Most of this association is in native grass and is used for grazing. A few small areas are cultivated. The potential is fair to poor for rangeland. On the steeper slopes the potential is poor for cultivated crops. In the gently sloping to strongly sloping areas, it is good to fair. The potential is poor for openland wildlife habitat, recreation, and most engineering uses. It is poor to very poor for trees. It is fair for rangeland wildlife habitat.

Ranches and farms on this association are mainly used for production of feeder cattle. Areas from other associations more favorable for cultivation extend into many ranch units. For this reason, many units produce sufficient feed grain and roughage.

The principal concern of management on this association is maintaining proper livestock grazing practices. Because of the high concentration of gypsum and lime, the soils are highly unstable and erosive. Water for livestock is limited to farm ponds. Deep wells and pipelines are alternatives for supplying stock water. The source of water for pipelines, however, is outside the association. Wells within the area yield a limited quantity of highly mineralized water, which may not be suitable for domestic use.

Farms and ranches on this association average about 1,200 acres. Some gravel or improved dirt roads cross the association. Only a few roads are on section lines. Nebraska Highway 12 and U.S. Highway 281 cross part of this association. Feeder cattle are produced and fed on local farms and ranches and generally are marketed at local livestock markets or at large terminals in Omaha and in Sioux City, Iowa.

Sandy soils on uplands

Two associations in this county consist of nearly level to steep, well drained and excessively drained sandy soils.

5. Dunday-Valentine-Simeon association

Deep, nearly level to moderately steep, well drained and excessively drained sandy soils formed in windblown and outwash sands and gravelly sands

This association is a sandy, nearly level plain partly covered with undulating smooth, round-topped hummocks. It is mostly nearly level to gently sloping (fig. 8) but is steeper in a few places on narrow divides along drainageways.

This association makes up about 7 percent of the county. It is about 36 percent Dunday soils, 20 percent Valen-

tine soils, 19 percent Simeon soils, and 25 percent minor soils.

Dunday soils are nearly level to strongly sloping. They occupy the lower part of the gently undulating hummocky areas that have been reworked by wind. They are steeper, however, along drainage divides and on hillsides. They are deep and well drained. Permeability is moderately rapid. Typically the surface layer is very friable loamy sand about 7 inches thick. The underlying material to a depth of 60 inches is lighter colored fine sand.

Valentine soils are very gently sloping to moderately steep. They occupy the upper part of hummocks and low sandhills, drainage divides, and hillsides. They are somewhat higher on the landscape than Dunday soils. They are excessively drained and rapidly permeable. Typically the surface layer is very friable loamy sand about 8 inches thick. The transition layer is about 6 inches of very friable fine sand. The underlying material to a depth of 60 inches is light colored fine sand.

Simeon soils are nearly level to gently sloping. They are slightly lower on the landscape than Dunday and Valentine soils. They formed in outwash sand and gravel. They are excessively drained and rapidly permeable. Typically the surface layer is very friable loamy sand about 8 inches thick. The transitional layer, 6 inches thick, is very friable loamy sand. The underlying layer to a depth of about 32 inches is lighter colored loamy coarse sand. Below this to about 60 inches is sand and coarse sand. Some fine gravel occurs throughout the soil.

Minor in this association are mainly Brocksburg, O'Neill, Ord, and Wewela soils. Brocksburg and O'Neill soils have gravelly underlying material and occupy positions similar to those of Simeon soils. The Ord soil is somewhat poorly drained, and the Wewela soil has a clay subsoil. Both are in slightly depressed areas.

Most of this association is rangeland. Some tracts are in cultivated crops. The potential is fair to poor for dryland crops and fair to good for irrigated crops. On the steeper slopes the potential is poor for all crops. The potential is fair to poor for tree planting, openland wildlife habitat, recreation, and most engineering uses. It is good for rangeland wildlife habitat.

Farms and ranches on this association are mostly for livestock grazing. The principal concerns of management are proper livestock grazing practices. Generally water in sufficient quantities for livestock and domestic use is easily obtained from wells. The potential for developing ground water supplies is limited because the layer of saturated coarse-textured sediments that overlies the shale is generally thin. In a few areas, sufficient water for irrigation is available. Severe depletion of the underground water supply can result if irrigation or public supply wells are closely spaced and developed to yield at the greatest possible rate. In areas where the shale is near the surface, obtaining any water is difficult.

The main irrigated crops are corn, alfalfa, and grain sorghum. Controlling soil blowing, maintaining fertility, and conserving moisture are the main concerns in cropland management.

Ranches and farms on this association average about 1,500 acres. Feeder cattle are most commonly produced for market in the local area. There are a few gravel or improved dirt roads on the association, mainly to individual ranch headquarters. No U.S. or Nebraska Highways cross this association.

6. Valentine-Simeon association

Deep, nearly level to steep, excessively drained sandy soils formed in windblown and outwash sands and gravelly sands

This association consists of an undulating outwash plain mantled with eolian sands and narrow, steep, dissected side slopes bordering drainageways. It is nearly level to steep.

This association makes up about 4 percent of the county. It is 47 percent Valentine soils, 29 percent Simeon soils, and 24 percent minor soils.

Valentine soils are gently sloping to steep. They are on hummocky and dunelike uplands. They are deep and excessively drained. Typically the surface layer is very friable fine sand about 5 inches thick. The underlying material to a depth of 60 inches is lighter colored loose fine sand.

Simeon soils are nearly level and gently sloping. They occur between the sand dunes and the steep upper side slopes of the drainageways. They are deep and excessively drained. Typically the surface layer is very friable loamy sand about 10 inches thick. Below this is a transition layer of very friable loamy sand about 6 inches thick. The underlying layer is lighter colored loamy coarse sand to a depth of about 34 inches and loose sand and coarse sand to 60 inches. Some fine gravel occurs throughout the soil.

Minor in this association are Dunday, Labu, Mariaville, Ord, and Wewela soils. Dunday soils, which have a thicker surface layer than Simeon and Valentine soils, are on the lower part of hummocks and on low ridges. The Ord soil is poorly drained. The Wewela soil is underlain by shale. Both are in slightly depressed areas. Mariaville soils, which formed in material weathered from siltstone, are below Simeon and Valentine on the side slopes. The clayey Labu soils, lowest on the landscape, occupy the lower side slopes of drainageways.

Almost all of this association is rangeland. A few small areas on the more gentle slopes are under cultivation. The potential for rangeland is generally good but is only fair on some of the steeper slopes. The potential is poor for cropland, tree planting, openland wildlife habitat, and recreation. The potential is fair for rangeland wildlife habitat and fair to poor for most engineering uses.

Ranches and farms on this association are mainly feeder cattle enterprises. Some farms include areas of other associations that have cropland potential. These farms are diversified, mainly cash grain and livestock enterprises.

The principal concerns of management on this association are maintaining range productivity and controlling soil blowing and water erosion. The native vegetation in some parts of the association has been depleted by continuous overuse. The overused range, supporting only short grasses and undesirable plants, is the less productive. Range productivity can be increased and erosion decreased under effective range and soil management.

Farms and ranches on this association average about 1,600 acres. Few gravel or improved roads cross the association. Farm produce is generally marketed at local auctions or at terminal markets in Sioux City, Iowa, or in Omaha.

Loamy and sandy soils on uplands

One association in this county consists of nearly level to moderately steep, well drained loamy and sandy soils.

7. Anselmo-Dunday-Blendon association

Deep, nearly level to moderately steep, well drained loamy and sandy soils formed in windblown sandy material

This association consists of mixed loamy and sandy soils that occur in a complex pattern on undulating to hummocky upland plains.

This association makes up about 4 percent of the county. It is about 41 percent Anselmo soils, 21 percent Dunday soils, 10 percent Blendon soils, and 28 percent minor soils.

Anselmo soils are gently sloping to moderately steep. They are deep and well drained. Permeability is moderately rapid. Typically the surface layer is about 11 inches thick. The subsoil is about 19 inches thick. The upper part is very friable fine sandy loam. The lower part is very friable sandy loam. The underlying material to a depth of 60 inches is lighter colored, loose loamy fine sand.

Dunday soils are nearly level to strongly sloping. They are generally on the higher hummocky areas and the steeper side slopes. They are deep and well drained. Permeability is moderately rapid or rapid. Typically the surface layer is about 14 inches thick. It is very friable loamy fine sand. The subsoil is very friable loamy sand about 6 inches thick. The underlying material to a depth of 60 inches is lighter colored fine sand.

Blendon soils are nearly level to gently sloping. They occupy slightly concave swales and foot slopes. Typically the surface layer is very friable fine sandy loam about 15 inches thick. The subsoil is very friable fine sandy loam about 7 inches thick. The dark color of the surface layer extends into the subsoil. The underlying material is lighter colored, very friable sandy loam to a depth of 42 inches and loamy sand to 60 inches.

Minor in this association are the silty Onita, Reliance, and Ree soils and the Mariaville and Paka soils, which formed over siltstone. Mariaville and Paka soils are generally below the Anselmo and Dunday soils. The silty soils are generally above the sandy Anselmo soils.

About 75 percent of this association is in cultivated crops. The rest, mainly steeper land, is used for grazing. The potential is good to fair for the commonly grown cultivated crops, grasses, trees, and shrubs. The potential for irrigated crops is good in the lower sloping areas and fair to poor in steeper areas. The supply of water for irrigation, however, is limited. This association has good to fair potential for openland and rangeland wildlife habitat and recreation uses. It has fair potential for rangeland and most engineering uses.

Farms on this association are diversified, mainly cash grain and livestock enterprises. Corn, grain sorghum, small grain, and alfalfa are the main crops. The small areas of pasture and rangeland are mostly on the steeper Anselmo and Dunday soils. Water for domestic use and livestock is available from shallow wells. The cattle fattened on farms are generally purchased as feeder calves. Hogs are commonly produced on the farms and fattened for market.

Water erosion on the steeper slopes and soil blowing are moderate to severe hazards. Controlling erosion, conserving moisture, and maintaining fertility are the main concerns of management. Lack of sufficient rainfall is the principal limitation to crop production.

Farms on this association average about 280 acres. Gravel or improved dirt roads are along most section lines. U.S. Highway 281 and Nebraska Highway 12 cross this association. Farm produce is generally marketed at local markets, elevators, or auctions, or at large terminals in Omaha and in Sioux City, Iowa.

Loamy soils on uplands underlain by sand and gravel

Two associations in this county consist of nearly level to moderately steep, well drained and excessively drained loamy soils over sand and gravel.

8. Meadin-Jansen-O'Neill association

Nearly level to moderately steep, well drained and excessively drained loamy soils that are shallow or moderately deep over sand and gravel; on upland divides and along drainageways

This association consists of nearly level to moderately steep soils bordering the drainageways and divides that dissect the old high terraces. The landscape is irregular, and the steeper hillsides are cut by numerous gullies (fig. 9).

This association makes up about 3 percent of the county. It is about 43 percent Meadin soils, 21 percent Jansen soils, 15 percent O'Neill soils, and 21 percent minor soils.

Meadin soils are gently sloping to moderately steep. They occur below Jansen soils and are slightly above or intermingled with O'Neill soils. They are excessively drained. Permeability is rapid in the surface layer and

very rapid in the underlying material. Typically the surface layer is friable sandy loam about 8 inches thick. The subsoil is friable gravelly sandy loam about 5 inches thick. The underlying material is lighter colored very gravelly coarse sand to a depth of about 26 inches and gravelly coarse sand to 60 inches.

Jansen soils are strongly sloping. They generally occur above Meadin soils, on the highest part of the landscape. They are well drained. Permeability is moderate in the surface layer and very rapid in the underlying material. Typically the surface layer is about 9 inches thick. The upper part is very friable loam. The lower part is friable silt loam. The subsoil is about 19 inches thick. The upper part is firm clay loam, and the lower part is firm sandy clay loam. The underlying material to a depth of 60 inches is lighter colored, loose gravelly sand.

O'Neill soils are nearly level to strongly sloping. Generally they occur below Meadin soils. They are well drained. Permeability is moderate to moderately rapid in the surface layer and very rapid in the underlying material. Typically the surface layer is friable fine sandy loam about 9 inches thick. The subsoil, about 17 inches thick, is friable fine sandy loam in the upper part and friable sandy loam in the lower part. The underlying material extends to a depth of 60 inches. It is very friable gravelly sandy loam in the upper part and gravelly coarse sand and gravelly sand in the lower part.

Minor in this association are Brocksburg, Labu, Mariaville, and Paka soils. The nearly level Brocksburg soils have a thicker surface layer than Jansen soils and are higher on the landscape. The steeper Mariaville soils, which formed in material weathered from siltstone, occur below Meadin soils. Paka soils, which also formed over siltstone, occur with O'Neill soils on the lower slopes. The steep Labu soils, which formed over shale, are the lowest on the landscape.

About 80 percent of this association, mainly the shallow soils and the steeper soils, is native rangeland. The cultivated acreage, mainly the moderately deep soils and the gently sloping soils, is near the heads of drainageways and on the lower foot slopes. The potential is very poor to fair for the commonly grown dryland cultivated crops, for pasture and trees and for openland wildlife habitat. It is fair to poor for rangeland. The droughty nature of the soils and the steep slopes are the main limitations. The potential is fair to good for rangeland wildlife habitat, recreation, and most engineering uses.

Farms and ranches on this association are diversified, mainly because almost all include parts of other associations better suited to cultivation. A combination livestock and cash grain enterprise is common. Cattle and hogs are commonly producd on the farms and fattened for market. Water from shallow wells is available, but only in limited amounts because the underlying layer of saturated coarse-textured sediments is generally inextensive and thin.

The principal concerns in management on the association are maintaining proper livestock grazing practices on the rangeland and controlling erosion, conserving moisture, and preserving a high level of fertility on the cropland.

Farms on this association average about 480 acres. Gravel or improved dirt roads are along most section lines. Nebraska Highway 12 crosses this association. Farm produce is generally marketed at local markets, elevators, or auctions, or at larger terminals in Omaha and in Sioux City, Iowa.

9. Brocksburg-Jansen association

Nearly level to gently sloping, well drained loamy soils that are moderately deep over sand and gravel; on uplands

This association consists of nearly level to gently sloping, moderately deep soils. It occurs as a series of old high terraces that have thin layers of loamy material over sandy or gravelly waterlaid sediments.

This association makes up about 2 percent of the county. It is about 46 percent Brocksburg soils, 40 percent Jansen soils, and 14 percent soils of minor extent.

Brocksburg soils are nearly level and in most places occupy the highest position on the landscape. Permeability is moderate in the subsoil and very rapid in the underlying material. Typically the surface layer is very friable loam about 14 inches thick. The subsoil is firm clay loam about 16 inches thick. The underlying material is calcareous, friable clay loam to a depth of 34 inches and gravelly coarse sand and gravelly sand to 60 inches.

Jansen soils are gently sloping in most places and are at the heads of drainageways. They are generally slightly below Brocksburg soils. Typically the surface soil is friable loam about 9 inches thick. The subsoil, about 23 inches thick, is firm loam in the upper part and firm clay loam in the lower part. The underlying material to a depth of 60 inches is light colored, loose gravelly coarse sand.

Minor in this association are Dunday, Meadin, Simeon, and Valentine soils. Dunday and Valentine soils are sandy and occupy slightly higher positions than Brocksburg soils. Meadin soils are shallow and are on the lower slopes. Simeon soils occupy positions similar to those of Brocksburg soils, but they are coarser textured.

Most of this association is in cultivated crops. All crops commonly grown in the county are suited. A few small, odd shaped areas remain in native rangeland. Droughtiness is common during prolonged dry periods because of the coarse underlying material. The potential is fair for the commonly grown dryland cultivated crops, rangeland grasses, trees, and shrubs. The potential is good for irrigated crops, but the supply of water for irrigation is inadequate. The potential is fair to good for openland and rangeland wildlife habitat and recreation uses. It is fair for most engineering uses.

Farms on this association are diversified, mainly cash grain and livestock enterprises. Corn, grain sorghum, small grain, and alfalfa are the main crops. Most farms have pastures and rangeland on steeper land that extends

into other associations. Cattle that are fattened on farms are produced on the farm or are purchased as feeder calves. Hogs are commonly produced on the farms and fattened for market. Domestic and livestock wells produce water in limited quantities.

Lack of sufficient moisture is the principal limitation to crop production. Controlling erosion, conserving moisture, and maintaining fertility are the main concerns of management.

Farms on this association average about 360 acres. Gravel roads are along most section lines. Nebraska Highway 12 is within 2 miles of this association. Farm produce is generally marketed at local markets, elevators, or auctions, or at larger terminals in Omaha and in Sioux city, Iowa.

Soils on bottom lands

Two associations in this county consist of nearly level to strongly sloping, well drained, excessively drained, somewhat poorly drained, and poorly drained soils of varying texture.

10. Inavale-Grigston-Cass association

Deep, nearly level to strongly sloping, well drained and somewhat excessively drained sandy, loamy, and silty soils formed in alluvial deposits

This association consists of soils on narrow bottom lands and low terraces adjacent to river channels and drainageways, other than the Missouri River. It is mostly a nearly level landscape cut by a few channels. In some areas where the sandy alluvium has been reworked by wind action, the landscape is hummocky.

This association makes up about 5 percent of the county. It is 35 percent Inavale soils, about 20 percent Grigston soils, 8 percent Cass soils, and 37 percent minor soils.

Inavale soils are nearly level and hummocky and are slightly higher in elevation than surrounding soils. There are some strongly sloping sand ridges 3 to 10 feet high. Inavale soils are deep and somewhat excessively drained. Permeability is rapid. Typically the surface layer is very friable loamy fine sand about 9 inches thick. A transitional layer of loose loamy sand is about 10 inches thick. The underlying material to a depth of 60 inches is lighter colored fine sand.

Grigston soils are nearly level. They occur on high bottom land and low terraces. They are deep and well drained. Permeability is moderate. Typically the surface layer is friable silt loam about 15 inches thick. The subsoil is friable silt loam about 16 inches thick. It is calcareous in the lower part. The underlying material is stratified friable loam to a depth of about 54 inches and very friable fine sandy loam to 60 inches.

Cass soils are nearly level. They are generally at slightly higher elevations than Grigston soils. They are deep and well drained. Permeability is moderately rapid. Typically the surface layer is friable fine sandy loam about 9 inches thick. There is a very friable fine sandy loam transition layer about 13 inches thick. The underlying material is lighter colored loamy fine sand to a depth of about 42 inches and fine and coarse sand to 60 inches.

Minor in this association are mainly Barney, Ord, Leshara, Hall, and Verdel soils. The poorly drained Barney soils and the somewhat poorly drained Ord and Leshara soils occur adjacent to the uplands and near the stream channels. The silty Hall and clayey Verdel soils are on the higher benches. The sandbars and islands are Riverwash.

About 60 percent of this association is cropland. The rest is native grassland. Most of the cropland acreage is on the higher bottoms and terraces, which are farthest from the stream. The grassland acreage is nearer the stream channels, is dissected by channels, and is sometimes flooded. It is used for grazing. The soils are coarser textured. The potential is generally good for the commonly grown dryland and irrigated crops, for pasture and rangeland, and for trees. It is poor in the channeled areas and on the windblown ridges. The potential is good or fair for openland and rangeland wildlife habitat and recreational uses. It is poor for most engineering uses.

Farms on this association are diversified. All are cash grain-livestock enterprises. Corn, grain sorghum, small grain, and alfalfa are the chief crops. The soils are mainly under dryland cultivation. Water for irrigation from both wells and stream diversion is insufficient. The occasionally or frequently flooded small areas near the stream channels are tame and native pastures. Some cattle and hogs are produced and fattened on the farms and marketed.

Soil blowing is a major hazard on the well drained sandy soils. Maintaining soil fertility is a concern in management.

Farms on this association average about 360 acres. Most farms extend into other associations. Most have access to gravel roads. Nebraska Highway 12 crosses a good part of the association, from Spencer to Monowi. Farm produce is marketed at local markets, elevators, or auctions, or at larger terminals in Omaha and in Sioux City, Iowa.

11. Haynie-Albaton-Onawa association

Deep, nearly level, moderately well drained to poorly drained silty and clayey soils formed in recent alluvial deposits

This association occurs as small, narrow areas on bottom land along the Missouri River. It is mainly nearly level, but in places oxbows and swales of old channels and floodwater deposited sediments have left the surface ridged and slightly undulating. The soils formed in fine to medium textured sediments laid down by water. The water table fluctuates between 1 foot and 10 feet.

This association makes up about 1 percent of the county. It is 27 percent Haynie soils, 16 percent Albaton soils, 13 percent Onawa soils, and 44 percent minor soils.

Haynie soils are at slightly higher elevations than the other major soils. They are deep, nearly level, and moderately well drained. Permeability is moderate. Typically the surface layer is very friable silt loam about 7 inches thick. The underlying material is very friable silt loam to a depth of 18 inches, stratified silt loam and very fine sandy loam to 46 inches, and fine sand to 60 inches.

Albaton soils occupy large areas in back swales at the base of the Missouri River bluffs and small areas in low lying swales and former stream channels. They are on the lowest part of the landscape. They are deep, nearly level, and poorly drained. Permeability is very slow. Typically the surface layer is firm silty clay about 7 inches thick. The underlying material is lighter colored, firm silty clay to a depth of about 27 inches and stratified silty clay and thin layers of silt loam to 60 inches.

Onawa soils are intermediate in elevation. They are deep, nearly level, and somewhat poorly drained. Permeability is slow in the surface layer and subsoil and moderately rapid in the underlying material. Typically the surface layer is firm silty clay about 7 inches thick. The underlying material is a firm silty clay to about 28 inches and stratified silt loam to 60 inches.

Minor in this association are Blake and Inavale soils and areas of Riverwash and water. Inavale soils are sandy and somewhat excessively drained. They occupy slightly undulating ridges and mounds along the edges of old stream channels and near the existing river channels. Blake soils are intermediate in texture and in position in the landscape between Haynie and Onawa soils. Riverwash occurs along the old stream channels only a few feet above the normal flow of the river. It is frequently flooded. The plant cover is mainly cattails and aquatic plants.

About 70 percent of this association is used for cultivated crops. The rest is still wooded and in native grass. The potential is fair to good for the commonly grown dryland cultivated crops, for pasture, and for trees. The potential for irrigated crops is good on the silty soils and fair on the clayey and sandy soils. The potential is good for rangeland. It is fair for openland wildlife habitat. It is poor for recreation development and most engineering uses.

Farms on this association are mainly cash grain enterprises. Some farms extend into the adjoining associations that are mainly rangeland. Such farms are more diversified. Hogs and some cattle are commonly produced and fattened for market.

Corn, grain sorghum, small grain, and alfalfa are the main crops. A few farms are sprinkler irrigated from the Missouri River. Wetness is a hazard where drainageways from the surrounding bluffs spill onto the flood plain. Floodways are needed to channel the excess floodwater across the flood plain to the river. Flooding from the Missouri River was once a hazard but is no longer of serious consequence since the mainstem Missouri River dams were built. Controlling erosion, conserving moisture, maintaining fertility, and tilling when soil moisture conditions are suitable are the main concerns of management.

Farms on this association average about 320 acres. Only one gravel road crosses this association. Farm produce is either marketed locally to elevators or auctions or delivered to major terminal markets in Sioux City, Iowa, or in Omaha.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Lynch series, for example, was named for the town of Lynch in Boyd County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Lynch silty clay, 6 to 11 percent slopes, is one of several phases within the Lynch series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Lynch-Bristow silty clays, 6 to 11 percent slopes, is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit.

Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Riverwash is an example.

The acreage and proportionate extent of each map unit are given in table 3, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Ab—Albaton silty clay, 0 to 2 percent slopes. This deep, nearly level, poorly drained soil is on bottom lands of the Missouri River Valley. It occurs in slightly depressional or narrow swalelike areas, which are old abandoned channels of the river, and in long narrow areas adjacent to the upland bluffs. Occasionally water runs in from adjoining land and ponds on the surface. The rare flooding by overflow from the Missouri River has been largely eliminated since construction of the large dams. Areas range from 50 to several hundred acres.

Typically the surface layer is firm, dark grayish brown silty clay about 7 inches thick. The underlying material to a depth of about 27 inches is firm, grayish brown silty clay. To about 54 inches it is stratified, grayish brown silty clay and light grayish brown silt loam. From 54 inches to 60 inches it is light gray silt loam. In a few places the surface layer is silty clay loam. In a few small areas sandy and silty materials occur below 40 inches.

Included with this soil in mapping are small areas of Blake, Haynie, and Onawa soils. Blake and Haynie soils occur at slightly higher elevations. Onawa soils, which formed in thinner clayey deposits, are slightly higher in elevation. These included areas make up 10 to 15 percent of the total acreage.

Permeability of this soil is very slow, and available water capacity is moderate. The shrink-swell potential is high. Runoff is slow. The organic-matter content is moderate, and the natural fertility level is medium. This soil absorbs moisture very slowly and releases it slowly to plants. It is difficult to work and to keep in good tilth. It is sticky when wet and very hard when dry. It can be tilled within only a narrow range of moisture content. In spring, during most years, the seasonal high water table fluctuates between depths of 1 and 3 feet.

Most of the acreage is in cultivated crops. Some small areas that have not been cleared for farming have a dense cover of trees and an understory of grass. These uncleared areas are used for grazing and as habitat for wildlife.

This soil has fair potential for dryland and irrigated cropland, windbreak plantings, and openland wildlife habitat. It has good potential for wetland habitat and for rangeland, tame pasture, and hay. It has poor potential for rangeland habitat and most recreational and engineering uses.

This soil is suited to most of the dryland crops grown in the county. Crop growth, however, is limited by the clayey texture, slow permeability, and slow runoff. The soil dries slowly in spring and stays wet during periods of heavy rainfall. If tilled when wet, it becomes cloddy and very hard. As it dries, large cracks form. The cracks can injure plant roots and cause excessive loss of moisture in the subsoil. Shallow cultivation when the soil is dry helps in maintaining a loose, finely granular condition at the surface and thus helps to lessen the loss of moisture.

Seedbed preparation and planting are commonly delayed in spring. Late planted crops, such as grain sorghum, soybeans, wheat, and alfalfa, are best suited. Forage sorghum for livestock feed and tame grasses for hay and pasture are also suited. Grain sorghum and soybeans can be planted later than corn. The soil can be worked in summer, and wheat can be planted in fall when the soil is likely to be dry. Legumes, especially alfalfa, have deep tap roots that tend to open the clayey soil.

Maintaining good tilth is a major concern of management. Wetness and soil blowing are hazards. Surface drainage can be improved by land shaping and constructing shallow V-drains to remove excess surface water. Tile drains are generally not suitable because permeability is very slow. Protecting the soil from heavy machinery and from grazing livestock in wet periods can help to reduce soil compaction. Fall plowing when moisture conditions are likely to be favorable results in better tilth in winter. Soil blowing can be controlled by leaving unplowed strips in the fields.

A cropping system that includes grasses and legumes and returns a large amount of organic matter to the soil improves soil structure and increases water intake.

If irrigated, this soil is suited to all crops commonly grown in the county. Corn, alfalfa, and wheat are the main irrigated crops. Leveling is needed if the soil is to be irrigated by a gravity system. Re-use systems can be installed at the lower end of fields to recycle the runoff from irrigation. Sprinkler irrigation is suitable, but the low intake rate of the soil requires a lower application rate than that permitted by the center-pivot system. Sprinklers that operate in sets at one location can be adjusted to provide the proper application rate. The conservation and cultural practices needed to control erosion are the same for both irrigated and dryfarmed areas.

The use of this soil for rangeland is effective in controlling soil blowing. Overgrazing and silt deposition, however, reduce the protective cover and deteriorate the potential plant community. Grazing when the soil is wet compacts the soil. Proper use and planned grazing systems help to maintain or improve the range and keep the soil in good condition.

Field windbreaks and feedlot windbreaks, range and livestock windbreaks, and recreation and wildlife plantings are all suited. Survival and growth are good if the selected trees can tolerate occasional wetness. Establishing seedlings can be a concern in wet periods. This soil shrinks when dry, and cracks form. This shrinking and cracking allows air to enter and dry out the roots of newly established plants. The abundant and persistent herbaceous vegetation that grows on this site is an additional concern of management in establishing seedlings.

Because of wetness and the hazard of occasional flooding, this soil is poorly suited as a building site. Dwellings should probably be located on alternate sites. Other buildings can be constructed on suitable fill material or pilings as protection against flooding and wetness from the water table. The abutting soil material next to foundations can be replaced with material that has little or no clay content and low shrink-swell properties. Shallow excavations should be dug during dry periods to avoid cave in and water problems.

The very slow permeability, the wetness, and the susceptibility to flooding severely limit the use of this soil for septic tank absorption fields and sanitary landfill areas. Other methods of sanitary disposal should be considered. Limitations are only slight for sewage lagoons. The flooding, wetness, low strength, and high shrink-swell potential are severe limitations for local roads and streets. Artificial drainage and elevated roadbeds may be a solution. The roadbed material can be modified to overcome the shrink-swell.

Capability units IIIw-1 dryland, IIIw-1 irrigated; Clayey Overflow range site; windbreak suitability group 2.

AnC—Anselmo fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on loamy uplands. Slopes range from long and plane to short, convex, and slightly undulating. Individual areas range from 10 to 40 acres.

Typically the surface layer is dark grayish brown, very friable fine sandy loam about 5 inches thick. The underlying material is brown sandy loam to a depth of 34 inches, brown loamy sand to 48 inches, and pale brown fine sand to 60 inches. In some areas the dark surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of Dunday, Paka, Ree, and Reliance soils. Dunday soils occupy positions on the landscape similar to those of this Anselmo soil. Paka soils occur in lower areas, and Ree and Reliance soils in higher areas. Included soils make up 10 to 15 percent of the mapped areas.

Permeability of this soil is moderately rapid, and available water capacity is moderate. The organic-matter content is low, and the natural fertility level is medium. Surface runoff is slow to medium. This soil is easy to till. It absorbs moisture and releases it readily to plants.

Most of the acreage is in cultivated crops. A few small areas remain in native grass. The soil has fair potential for the common cultivated crops and grasses, good potential for trees and shrubs in windbreaks, good potential for openland and rangeland wildlife habitat and for recreational uses, and fair potential for most engineering uses.

This soil is suited to dryland corn, alfalfa, oats, and grain sorghum. It is moderately susceptible to soil blowing and slightly susceptible to water erosion. It is droughty in years of below average rainfall. Conservation tillage, which leaves crop residue on the surface, along with contour farming, stripcropping, and field windbreaks reduce the risk of erosion and conserve moisture.

If irrigated, this soil is suited to most crops grown in the county. Sprinklers are generally most practical. Water applications should be light but frequent. The conservation practices needed to control erosion are the same in both irrigated and dryfarmed areas.

This soil is well suited to rangeland. Using it as range is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and possibly blowouts. Proper use, timely deferment of grazing and haying, and planned grazing systems help to maintain or improve the range condition and keep the soil in good condition.

This soil is suited to windbreak plantings if soil blowing is controlled by maintaining strips of sod or other vegetation between the rows. Drought and competition for moisture from grass and weeds are hazards. Only tree and shrub species tolerant of somewhat droughty conditions are suited.

This soil is well suited to dwellings and septic tank filter fields. Seepage is a problem in sewage lagoons unless the bottom is sealed by special treatment. The susceptibility to frost heaving makes this soil only fairly well suited to local roads and streets.

Capability units IIIe-3 dryland, IIIe-8 irrigated; Sandy range site; windbreak suitability group 3.

AnD—Anselmo fine sandy loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on side slopes of drainageways and on rolling upland divides. Individual areas are 15 to 200 acres.

Typically the surface layer is dark gray, very friable fine sandy loam about 11 inches thick. The subsoil is about 19 inches thick. The upper part is grayish brown and brown, very friable fine sandy loam, and the lower part is a light brownish gray, very friable sandy loam. The underlying material to a depth of 60 inches is pale brown, loose loamy fine sand. In a few areas the surface layer is loam.

Included with this soil in mapping are areas of Ree and Reliance soils. They generally occupy higher areas on the landscape. Also included are small areas of a steeper Anselmo soil. Included soils make up 5 to 15 percent of the mapped areas.

Permeability is moderately rapid, and available water capacity is moderate. The organic-matter content is low, and the natural fertility level is medium. Surface runoff is moderate. This soil is easy to till. It absorbs moisture and releases it readily to plants.

About half the acreage is cultivated. The rest is in native grass. The soil has fair potential for rangeland and pasture. It has good potential for openland and rangeland wildlife habitat and for windbreak plantings. It has fair potential for cultivated crops, recreational facilities, and most engineering uses.

This soil is poorly suited to most crops commonly grown in the county, including corn, oats, grain sorghum, alfalfa, and tame grasses. The soil is moderately susceptible to blowing. Stripcropping and conservation tillage, which leaves crop residue on the surface, are effective in controlling soil blowing. Because of slope, water erosion also is a moderate hazard. Where feasible, terraces, grassed waterways, and contour farming, along with conservation tillage, help to protect the soil from water erosion. Grassed waterways are difficult to establish and maintain. Mulching with an organic mulch immediately after seeding helps to prevent gully erosion while the waterways are being established.

Sprinkler irrigation is the only method suitable on this soil because of slope. Water applications should be light but frequent. Close spaced crops, legumes, and grass should be grown. The conservation practices needed to control erosion are the same in both irrigated and dryfarmed areas.

This soil is suited as rangeland. Using it as range is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in severe soil losses from soil blowing. Proper use, timely deferment of grazing or haying, and planned grazing systems help to maintain or improve the range and keep the soil in good condition.

This soil provides good tree planting sites. Only tree and shrub species tolerant of somewhat droughty conditions are suited. Soil blowing is a major limitation, and water erosion is a hazard on this strongly sloping soil. The risk of soil blowing can be reduced by maintaining strips of sod or other vegetation between rows. Cultivation should be restricted to the areas between the tree rows.

This soil has slight to moderate limitations for dwellings. Erosion control is needed. Slope is a moderate limitation for shallow excavations. Lateral seepage or downslope flow of effluent is a problem in establishing septic tank filter fields. Drainage trenches should be installed on the contour so that the effluent disperses throughout the absorption field. Frost action is a moderate limitation in constructing local roads and streets. The soil is poorly suited to pond reservoir areas because of seepage below 2 feet.

Capability unit IVe-3 dryland, IVe-8 irrigated; Sandy range site; windbreak suitability group 3.

AnF—Anselmo fine sandy loam, 11 to 20 percent slopes. This deep, moderately steep, well drained soil is on side slopes of drainageways. Individual areas are irregular in shape and range from 15 to 150 acres.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 11 inches thick. The subsoil is about 21 inches thick. The upper part is brown, very friable fine sandy loam, and the lower part is yellowish brown, friable fine sandy loam. The underlying material is yellowish brown loamy fine sand to a depth of about 44 inches and very pale brown, loose fine sand to 60 inches. In some places the surface layer is loam.

Included with this soil in mapping are small areas of Dunday, Mariaville, Paka, and Labu soils. Dunday soils are generally higher on the landscape than the Anselmo soil. Mariaville and Paka soils are generally lower, and the areas of Labu soils are the lowest. Included soils make up 10 to 15 percent of the mapped areas.

Permeability is moderately rapid, and available water capacity is moderate. The organic-matter content is low, and natural fertility is medium. Surface runoff is moderate to rapid. The soil absorbs moisture and releases it readily to plants.

Almost all the acreage is in native grass and is used for grazing. This soil is too steep for cultivated crops. It has fair potential for rangeland and good potential for rangeland wildlife habitat. It has poor potential for recreational uses and fair potential for windbreak plantings. It has fair to poor potential for most engineering uses.

This soil is best suited as rangeland. Unless protected by a plant cover, it is moderately susceptible to soil blowing and highly susceptible to water erosion. Using the soil as range is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. As a result, gullies form. Proper use, timely deferment of grazing or haying, or a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is fairly well suited to windbreak plantings, but water erosion is a severe hazard on these moderately steep slopes. Soil blowing also is a hazard if trees are cultivated. Planting on the contour and maintaining strips of sod between the rows are effective in controlling erosion. Only tree and shrub species tolerant of somewhat droughty conditions are suited.

This moderately steep soil has moderate to severe limitations for dwellings and septic tank absorption fields. For dwellings, erosion control is needed. Lateral seepage or downslope flow of effluent is a problem in establishing septic tank absorption fields. Drainage trenches should be installed on the contour so that effluent is dispersed throughout the absorption field. Frost action and erodible slopes are problems in constructing local roads and streets. The soil is poorly suited to pond reservoirs because of seepage.

Capability unit VIe-3 dryland; Sandy range site; windbreak suitability group 7.

ArF—Anselmo-Rock outcrop complex, 11 to 20 percent slopes. This map unit consists of moderately steep, well drained soils and rock outcrop (fig. 10). Most areas are on the upper side slopes of larger drainageways. In-

dividual areas range from 5 to 100 acres. Anselmo soils make up 65 percent of the unit, Rock outcrop 15 to 20 percent, and other soils as much as 20 percent. The Rock outcrop occurs as ledges that approximate the contour of the drainageways. Many boulders and rock fragments have moved downslope from the ledges. The Anselmo soil is between the boulders and the rock ledges.

Typically the Anselmo soil has a dark grayish brown, very friable fine sandy loam surface layer about 10 inches thick. The subsoil is about 20 inches thick. The upper part is brown, very friable sandy loam, and the lower part is yellowish brown, very friable loamy fine sand. The underlying material is light yellowish brown loamy fine sand to a depth of about 42 inches and very pale brown fine sand to 60 inches. As much as 25 percent of some areas is a soil that is moderately deep over sandstone.

The Rock outcrop is bare quartzite and sandstone.

As much as 15 to 25 percent of this unit is included small areas of Labu and Reliance soils and a loamy soil that is shallow over sandstone. Reliance soils are higher on the landscape and more gently sloping. Labu soils are lower on the side slopes.

Permeability is moderately rapid on the Anselmo soil, and available water capacity is moderate. The organic-matter content is low, and the fertility level is medium. Surface runoff is moderate to rapid. On the Rock outcrop, runoff is very rapid. There is very little root development in the Rock outcrop, except in the fissures and cracks and in the pockets of sand.

Almost all the acreage is in native grass and is used for grazing. This map unit has fair potential for range and rangeland wildlife habitat. It has very poor potential for cultivated crops and poor potential for windbreak plantings and most engineering uses.

Range is the best use for this unit. The major problems of management are related to the hazard of water erosion. The rapid runoff from the outcrop cuts deep gullies in the surrounding steep sandy soils. Soil blowing also is a hazard. Maintaining adequate plant cover and ground mulch helps to prevent excessive soil losses. Overgrazing reduces the protective cover and deteriorates the native plant community. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

The Rock outcrop and the moderately steep slopes prevent the use of this unit for cultivated crops. The outcrop also prevents the use of the planting and cultivation equipment needed in establishing windbreaks. In the larger areas of Anselmo soil, a few trees and shrubs can be carefully planted and tended. In such areas, lack of moisture and the risk of severe water erosion and soil blowing are the principal hazards in establishing seedlings. Only tree and shrub species tolerant of slightly sandy, somewhat droughty conditions should be used. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows.

This unit is generally not suitable for building sites, septic tank absorption fields, or sewage lagoons. It has some use for recreation facilities and wildlife habitat. Limitations for pond reservoirs are severe because the rock is not rippable and seepage is high in this sandy loam.

Capability unit VIe-3; Anselmo soil in Sandy range site, windbreak suitability group 7; Rock outcrop in windbreak suitability group 10.

Ba—Barney silt loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on bottom lands of the major streams. It is frequently flooded. Individual areas are 5 to 60 acres.

Typically the surface layer is grayish brown and is about 10 inches thick. The upper part is friable silt loam, and the lower part is very friable sandy loam. The underlying material is loose fine sand with some coarse sand and gravel, and it extends to a depth of 60 inches. In some places the surface layer is silty clay loam, loam, sandy loam, fine sandy loam, or loamy fine sand.

Included with this soil in mapping are small areas of Inavale, Grigston, Leshara, and Ord soils and Riverwash. Inavale and Grigston soils are on the higher levels. Leshara and Ord soils are at slightly higher elevations. Riverwash is lowest on the landscape. These included areas make up as much as 15 percent of each mapped area.

Permeability is moderately rapid in the surface layer and very rapid in the underlying layers. Runoff is very slow. Available water capacity is low. The organic-matter content is moderately low, and natural fertility is medium. In most years, the seasonal high water table fluctuates between the surface and a depth of 2 feet. This soil is frequently flooded for a moderate period early in spring when streamflow is highest.

Most of the acreage is range or hayland. The soil has very poor potential for cultivated crops. It has poor potential for windbreak plantings, openland wildlife habitat, recreational development, and most engineering uses. It has good potential for pasture and rangeland and fair potential for rangeland wildlife habitat. Potential for wetland habitat is good.

This soil is not suited to cultivation because it is too wet and too shallow over sand and gravel. Using it as rangeland, for either grazing or haying, is effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover and deteriorate the potential native plant community. If overgrazed when wet, the soil compacts and hummocks form. Proper use and timely deferment of grazing or haying, along with restricted use during wet periods, help to maintain the plant community and soil in good condition.

This soil is not suited to field windbreaks or farmstead and feedlot windbreaks. It is somewhat suited, however, to livestock protection windbreaks and wildlife plantings. Only tree and shrub species tolerant of a very high water table are suited. Establishing trees can be a problem in wet periods. Special methods of planting may be needed so that seedlings do not drown.

This soil is generally not suitable as a site for buildings and sanitary disposal facilities because of the high water table and frequent flooding.

Capability unit Vw-7; Wetland range site; windbreak suitability group 6.

Bd—Blake silty clay loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on bottom lands of the Missouri River Valley. Areas are irregular in shape and roughly parallel the old abandoned drainage channels of the river. This soil is subject to occasional flooding when water runs in from adjoining lands. The rare flooding by the overflow from the Missouri River has been largely eliminated since construction of the large dams. Areas range from 20 to 100 acres.

Typically the surface layer is friable, grayish brown silty clay loam about 8 inches thick. The underlying material to a depth of about 25 inches is grayish brown silty clay loam and thin strata of higher clay content. From 25 inches to 60 inches it is light brownish gray very fine sandy loam stratified with coarse silt loam and silty clay loam. In some places the surface layer is thicker and darker colored than is typical.

Included with this soil in mapping are small areas of Albaton, Haynie, and Onawa soils. Albaton and Onawa soils are at slightly lower elevations than Blake soils. Haynie soils are at slightly higher elevations. These included soils make up 5 to 15 percent of the total acreage.

Permeability is moderately slow in the upper part and moderately rapid in the underlying material. Available water capacity is high. The organic-matter content is low, and the natural fertility level is medium. The soil absorbs moisture easily and releases it readily to plants. It is generally in good tilth and is easy to work. Runoff is slow. The shrink-swell potential is high in the upper 25 inches and moderate below. Depth to the seasonal high water table is 2 to 4 feet in spring.

Most of the acreage is in cultivated crops. A few small areas near the river are wooded and have an understory of grass. These areas are used as range and as habitat for wildlife.

This soil has good potential for dryland and irrigated crops, pasture and range, windbreak plantings, and openland wildlife habitat. It has fair potential for wetland habitat and recreational uses and poor potential for most engineering uses.

This soil is suited to all of the dryland crops commonly grown in the county. It is especially suited to such row crops as corn, grain sorghum, and soybeans. Row crops can be grown year after year if proper amounts of fertilizer are added and if weeds, diseases, and insects are controlled. Crops respond well to nitrogen fertilizer. The soil is also well suited to pasture.

Grassed waterways help to carry runoff from this soil. In places, diversion ditches can intercept the runoff from adjacent higher areas. Floodways constructed across some areas can channel runoff to the river. Conservation tillage, which leaves crop residue on the surface, helps to control soil blowing and conserve moisture in areas that are cultivated year after year. A cropping system that returns a large amount of organic matter to the soil improves soil structure and increases water intake.

If irrigated, this soil is suited to all crops commonly grown in the county. Corn is the main irrigated crop, but alfalfa, grain sorghum, and tame grasses are also grown. Land grading is needed for a more uniform application under gravity irrigation. Furrows, borders, and sprinklers are suitable. The amount of irrigation water and the time and duration of its application should be carefully managed to prevent waste.

The use of this soil for rangeland is effective in controlling erosion. Overgrazing the range reduces the protective plant cover and thus deteriorates the plant community. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil is well suited to field, farmstead, feedlot, and livestock protection windbreaks and to recreation and wildlife plantings. All tree and shrub species climatically adapted are suited. Moisture competition from grass and weeds is a concern in establishing seedlings and managing the woodland.

Where flooding is a hazard, this soil is not suitable as a site for dwellings. In areas protected from flooding, the wetness, low strength, and shrink-swell are moderate limitations. Artificial drainage and footing drains are needed. The abutting soil material next to foundations and basement walls can be replaced with readily available material that has little or no clay content and low shrink-swell properties.

Septic tank absorption fields may not operate properly on this soil during wet periods. Flood protection is needed in some areas. Seepage and occasional flooding are severe limitations for sewage lagoons.

The low strength of the subgrade material and the hazards of flooding and frost action are severe limitations for local roads and streets. The road base can be strengthened and the material modified to overcome frost action.

Capability unit I-1 dryland, I-1 irrigated; Clayey Overflow range site; windbreak suitability group 1.

Be—Blendon fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil occupies stream terraces, colluvial fans, and upland swales. Areas range from 5 to 35 acres.

Typically the surface layer is dark grayish brown, very friable fine sandy loam about 16 inches thick. The subsoil is about 10 inches thick. The upper part is dark grayish brown, friable fine sandy loam. The lower part is brown, very friable sandy loam. The underlying material is brown loamy fine sand to about 34 inches and very pale brown loamy sand to 60 inches. In a few areas the surface layer is loam.

Included with this soil in mapping are small areas of Anselmo, Dunday, and Paka soils. Anselmo and Dunday soils are higher on the landscape than this Blendon soil. Paka soils occupy positions similar to those of the Blendon soil. These included areas make up less than 15 percent of each mapped area.

Permeability is moderately rapid over rapid, and the available water capacity is moderate. Runoff is slow. The soil absorbs moisture easily and releases it readily to plants. It is in good tilth and easy to work. The organic-matter content is moderately low, and natural fertility is medium. Reaction is slightly acid or neutral. Shrink-swell potential is low.

Most of the acreage is cultivated. A few small areas remain in native grass.

This soil has good potential for the commonly grown crops and trees. It has good potential for rangeland, openland and rangeland wildlife habitat, and recreation. It has fair potential for most engineering uses.

This soil is well suited to dryland corn, oats, grain sorghum, alfalfa, and tame grasses. The hazards of soil blowing and water erosion are slight to moderate. Conservation tillage, which leaves crop residue on the surface, reduces the risk of soil blowing and water erosion and conserves moisture. A cropping system that includes legumes, grasses, or a mixture of both helps to replenish organic matter, maintain fertility, and control soil blowing.

Under irrigation, this soil is suited to most crops commonly grown in the county. Corn and alfalfa are the main crops. For gravity irrigation, some land leveling is generally needed. Because of the coarse textured subsoil and underlying material, shorter irrigation runs are needed than on comparable deep silty soils. Sprinklers also are suitable. If this soil is irrigated by sprinklers, the cropping system and conservation practices needed are the same as those needed in dryfarmed areas.

The use of this soil for rangeland is effective in controlling erosion. Overgrazing or improper haying methods reduce the protective cover and thus deteriorate the potential native plant community. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil provides good sites for field windbreaks, farmstead and feedlot windbreaks, and recreation and wildlife plantings. Tree and shrub species that are tolerant of slightly sandy, somewhat droughty conditions can be selected. Lack of adequate moisture and soil blowing are the main limitations. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. Cultivation generally should be restricted to the tree rows. Selective chemical herbicides can eliminate weed competition within the tree rows and thus conserve moisture.

This soil is suited to dwellings. If well compacted and confined, it has fair to good bearing capacity. It is suited to septic tank absorption fields. It is not suited to sewage lagoons because of excessive seepage. Sealing or lining the bottom and sides with impervious material is needed. Possible frost action and low strength are moderate limitations in constructing local roads and streets. Mixing the soil material and treating it with additives may be needed.

Capability unit IIe-3 dryland, IIe-8 irrigated; Sandy range site; windbreak suitability group 3.

BeC—Blendon fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on sloping uplands and in concave swales. A few areas are on alluvial fans and stream terraces. Individual areas range from 10 to 80 acres.

Typically the surface layer is dark grayish brown, very friable fine sandy loam about 16 inches thick. The subsoil is dark grayish brown, very friable fine sandy loam about 6 inches thick. The underlying material is brown, very friable sandy loam to a depth of about 42 inches and light yellowish brown loamy sand to 60 inches. In some profiles the surface layer is loam.

Included with this soil in mapping are small areas of Anselmo, Dunday, Onita, and Paka soils. Anselmo and Dunday soils are generally slightly higher on the landscape than this Blendon soil. Onita and Paka soils occupy positions similar to those of the Blendon soil. These included soils make up 10 to 15 percent of each mapped area.

Permeability is moderately rapid over rapid. The available water capacity is moderate, and surface runoff is slow. This soil absorbs water well and releases it readily to plants. It is in good tilth and is easy to work. The organic-matter content is moderately low, and natural fertility is medium. Reaction is slightly acid or neutral. The shrink-swell potential is low.

Almost all the acreage is cultivated. A few small irregularly shaped areas are still native grassland.

The soil has fair potential for the commonly grown cultivated crops and grasses. It has good potential for windbreaks, openland and rangeland wildlife habitat, and recreational uses. It has fair potential for most engineering uses.

This soil can be used for dryland corn, oats, grain sorghum, alfalfa, and tame grasses. It is subject to soil blowing. The hazard of water erosion is slight. Conserving moisture and maintaining the organic-matter content and high fertility are concerns of management. Terracing and conservation tillage, which leaves crop residue on the surface, control erosion and conserve moisture in areas that are cultivated year after year. A cropping system that alternates row crops with small grain or legumes and grasses helps to replenish the supply of organic matter, maintain fertility, and control soil blowing.

Under irrigation, corn and alfalfa are the main crops. Small grain, sorghum, and grasses are also suited. Furrows and borders are suitable in the more gently sloping areas if the land is leveled and the length of runs is kept short. Sprinklers are suitable in areas where land leveling is not practical. Frequent and light irrigation is needed. The conservation practices needed to control erosion are the same in both irrigated and dryfarmed areas.

Rangeland use of this soil is effective in controlling erosion. Overgrazing the range reduces the protective cover and deteriorates the potential native plant community. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range condition and keep the soil in good condition.

This soil is suited to tree plantings in field windbreaks, farmstead and feedlot windbreaks, and range or livestock windbreaks. It is also suited to recreation or wildlife plantings. Soil blowing and lack of moisture are the main hazards in establishing seedlings. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation should be restricted to the tree rows. Selective chemical herbicides also can be used to control weeds within the rows. Water erosion can be a hazard in the more sloping areas. Only trees and shrubs that are tolerant of slightly sandy, somewhat droughty conditions are suited.

This soil is fairly well suited as a building site. If well compacted and confined, it has fair to good bearing capacity. Limitations are moderate in the sloping areas. In such areas grading to modify the slope or designing buildings that complement the slope may be needed. Septic tank absorption fields can be adapted to this soil. In some areas pollution of nearby ground water supplies can be a problem. Seepage is a severe limitation in sewage lagoons. The sides and bottoms of lagoons can be sealed with impervious material, or other methods of sewage treatment should be considered.

Possible frost action and low strength are moderate limitations in constructing local roads and streets. Mixing the soil material and treating it with additives may be needed.

Capability unit IIIe-3 dryland, IIIe-8 irrigated; Sandy range site; windbreak suitability group 3.

BoD—Boyd silty clay, 6 to 11 percent slopes. This moderately deep, well drained, strongly sloping soil is on convex ridgetops and lower side slopes of the uplands. Individual areas are 10 to 80 acres.

Typically the surface layer is friable, dark gray silty clay about 6 inches thick. The subsoil is about 16 inches thick. It is friable, dark grayish brown silty clay in the upper part and firm, grayish brown clay in the lower part. The underlying material, about 10 inches thick, is extremely firm olive clay. Pale olive shaly clay and bedded shale is below 32 inches. In places the soil has a light colored surface layer.

Included with this soil in mapping are small areas of the deep Promise soils, which are on the lower foot slopes, and the shallow Sansarc soils, which are on the narrow convex ridges and the steep, sharp slope breaks above. These included soils make up no more than 10 percent of the total mapped area.

The Boyd soil has low available water capacity and slow permeability. It releases water slowly to plants and is droughty in most years. Runoff is medium or rapid. The shrink-swell potential is high. The intake rate is generally slow, but when deep cracks form, the initial intake rate can be rapid. This soil is moderately low in organic-matter content and medium in natural fertility. It is in poor tilth and is difficult to cultivate. It puddles if worked when wet.

About 40 percent of the acreage is cultivated. The rest is in native grass.

The soil has poor potential for farming and windbreak plantings and fair potential for range. It has poor potential for most engineering uses. It has fair potential for openland and rangeland wildlife habitat.

Dryland oats, barley, grain sorghum, and alfalfa for hay are suitable crops. In most years, alfalfa produces one cutting of hay and one seed crop.

Controlling erosion is the main management need. Conserving moisture and maintaining fertility and good tilth are other needs. Terracing and conservation tillage, which leaves crop residue on the surface, control erosion and conserve moisture in areas that are cultivated year after year. Growing grasses and legumes in the cropping system about half the time improves tilth and the organic-matter content. A grass cover helps in controlling erosion in natural drainageways.

This soil is suited to range. Management that maintains an adequate cover of native grasses is effective in controlling water erosion. Overgrazing reduces the protective cover and deteriorates the native plant community. The soil puddles if grazed when wet. Proper use, timely use, and a planned grazing system maintain or improve the range and keep the soil in good condition.

This soil is not suited to field windbreaks. It is poorly suited to farmstead and feedlot windbreaks and to wildlife and recreation plantings. Growth of trees and shrubs is poor because of the high clay content. Suggested plantings are limited to only the drought-tolerant species.

This soil is poorly suited as a building site. Septic tanks should not be installed. Effluent can rise to the surface or seep out downslope because the soil is only moderately deep over shale. Because of the slow percolation rate a larger-than-normal absorption field may be needed. A more suitable site in deeper, less sloping soils is needed. Boyd soils are generally not suitable for dwellings because of the high shrink-swell. Foundations and basement walls should be designed to withstand the shrinking and swelling actions of the soil. Tile drains can be used to prevent saturation of the abutting soil material or the material can be replaced with material having little or no clay content.

The high shrink-swell potential and low strength are severe limitations for local roads. Grading the roadbed to shed water and replacing or modifying the soil base material is needed.

Capability unit IVe-4; Clayey range site; windbreak suitability group 9.

BrG—Bristow silty clay, 20 to 40 percent slopes. This steep and very steep, shallow, well drained soil is on upland ridges and side slopes. It is underlain by light shale and is lower on the landscape than the Labu and Sansarc soils that formed in dark shale. Areas of this soil are generally irregular in shape and range from 20 to 400 acres.

Typically the surface layer is pale brown, friable silty clay about 7 inches thick. The underlying material is about 10 inches thick. It is light yellowish brown shaly clay. Pale yellow and yellow bedded shale is at a depth of about 17 inches.

Included with this soil in mapping are small areas of Lynch soils on the broader convex ridgetops and lower side slopes where the depth to shale is more than 20 inches. These included soils make up to 20 percent of each mapped area.

This soil has slow permeability. Surface runoff is very rapid, and the available water capacity is very low. The organic-matter content is low, and natural fertility is low. The soil has poor tilth. It is moderately alkaline throughout. Many fine roots extend to bedded shale. A few enter the parent shale between fragments.

Almost all the acreage is in native grass and is used for grazing. The soil has very poor potential for farming and poor potential for tree and shrub plantings, wildlife habitat, and most engineering uses. It also has poor potential for range and recreational facilities.

This unit is best suited to range. Because of the steep slopes and high content of gypsum and lime, the soil is very unstable. Intensive grazing pressure causes vertical movement of the soil. Cat-step benches form on the steep slopes. The thin surface layer erodes. Gullies form readily. Very little forage is produced. Grazing should be carefully controlled so that a protective cover of vegetation is maintained. Proper range use, consisting of proper stocking rates, uniform grazing distribution, deferred grazing, and a planned grazing system, helps to keep the range in good condition.

This soil is not suited to cultivated crops because of the steep slopes and the clayey texture. It is not generally suited to windbreak plantings of any kind because of the steep slopes and the unfavorable soil characteristics.

Dwellings, sanitary disposal systems, and local roads are not suited because of the steep slopes and the unstable nature of the shale. Sites of deeper, less sloping soils are needed on the foot slopes or on the broad ridgetops.

Capability unit VIIs-4; Shallow Limy range site; windbreak suitability group 10.

Bs—Brocksburg fine sandy loam, 0 to 2 percent slopes. This is a well drained, nearly level soil that is moderately deep over sand and gravel. It is on broad tablelands. Individual areas range from 15 to 200 acres.

Typically the surface layer is dark grayish brown, very friable fine sandy loam about 18 inches thick. The subsoil is about 14 inches thick. The upper part is dark brown, friable loam, and the lower part is brown, firm clay loam. The underlying material to a depth of about 60 inches is pale brown gravelly sand. In some areas the surface layer is loamy fine sand. In a few areas the clay loam subsoil is at a depth of 24 to 30 inches. In some areas the soil is dark colored to a depth of less than 20 inches.

Included with this soil in mapping are small areas of Anselmo, Dunday, O'Neill, Simeon, and Valentine soils. O'Neill and Simeon soils occupy positions on the landscape similar to those of the Brocksburg soil. Anselmo, Dunday, and Valentine are slightly higher. Included soils make up about 10 percent of each mapped area.

Permeability is moderate through the subsoil and very rapid through the underlying material. Surface runoff is slow. The shrink-swell potential is low in the surface layer, moderate in the subsoil, and low in the underlying material. The available water capacity is moderate. The organic-matter content is moderate, and natural fertility is medium. Root penetration is mainly restricted by the underlying sand and gravel.

About 80 percent of the acreage is cultivated. The rest is mainly in native grass. The soil has fair potential for the commonly grown cultivated dryland crops and for grasses and windbreaks. It has good potential for irrigated crops, rangeland wildlife habitat, and recreation and fair potential for rangeland and most engineering uses.

Dryland corn, grain sorghum, oats, alfalfa, and tame grasses are the main crops. Because of the moderately deep root zone and the limited rainfall, this soil is droughty during some part of the growing season. Soil blowing is the main hazard. Conserving moisture and maintaining fertility and good tilth are important parts of management. Soil blowing can be controlled by using conservation tillage, wind stripcropping, planting cover crops, and establishing field windbreaks. Fertilizer or barnyard manure is needed to maintain fertility. Such cover crops as small grain and legumes in the cropping sequence help in maintaining tilth and in breaking the insect and disease cycles.

Under irrigation, corn, sorghum, alfalfa, and tame grasses can be grown. Control of soil blowing, maintenance of fertility, and proper management of water are needed. Nitrogen fertilizer is needed for sustained production. Some land leveling is needed for gravity irrigation systems. Sprinklers also are suitable on this soil. The surface layer absorbs water readily, but the subsoil is only moderately permeable. The rate of water application should be designed for this layer, so that ponding in low or depressed areas can be avoided.

This soil can be used for range, which is effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods reduce the protective cover, thus deteriorating the potential native plant community. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil provides fair sites for planting trees. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the rows. Cultivation generally should be restricted to the tree rows. Drought and competition for moisture from grass and weeds are limitations. Suggested plantings are limited to the drought-tolerant species of trees and shrubs.

This soil is fair as a site for dwellings and local roads. The main limitation is the moderate shrink-swell potential. Replacing the soil material abutting foundations and basement walls with readily available sandy material is needed. Sewage lagoons are severely limited because of seepage into the coarse underlying material.

Capability unit IIe-3 dryland, IIe-9 irrigated; Sandy range site; windbreak suitability group 5.

Bt—Brocksburg loam, 0 to 2 percent slopes. This well drained, nearly level soil is moderately deep over sand and gravel. It is on broad tablelands. Individual areas range from 25 to several hundred acres.

Typically the surface layer is dark grayish brown, very friable loam about 14 inches thick. The subsoil is brown, firm clay loam about 16 inches thick. The underlying material is 4 inches of grayish brown clay loam over gravelly coarse sand at a depth of 34 inches. The upper part is darker than the lower part. In a few areas, the surface layer is silt loam or fine sandy loam. In a few areas the surface layer is thinner and the upper subsoil is browner than is typical.

Included with this soil in mapping are small areas of Meadin soils, which have sand and gravel at a depth of less than 20 inches. These included soils make up about 15 to 20 percent of the mapped areas.

Permeability is moderate in the subsoil and very rapid in the underlying material. Surface runoff is slow. The shrink-swell potential is low in the surface layer, moderate in the subsoil, and very low in the underlying material. Available water capacity is moderate. The organic-matter content is moderate, and natural fertility is medium. Root penetration is mainly restricted by the underlying sand and gravel.

Most of the acreage is cultivated. A few small isolated areas are in native grass.

The soil has fair potential for dryland crops and good potential for irrigated crops. It has fair potential for rangeland. It has good potential for wildlife habitat and recreation and fair potential for windbreaks and most engineering uses.

This soil is used for dryland corn, grain sorghum, small grain, and alfalfa. These crops are droughty almost every summer because the root zone is only moderately deep and rainfall is limited. Small grain and the first cutting of alfalfa are generally more dependable crops because they grow and mature in spring when rainfall is highest. Soil moisture can be conserved and the risk of water erosion reduced by using a cropping system that keeps the soil covered with crop mulches most of the time. Tillage that leaves residue on the surface also improves tilth and permeability and helps to increase the organic-matter content.

If irrigated, this soil can be used for corn, sorghum, and alfalfa. In most areas land leveling is needed for furrow and border irrigation. Measures are needed to reduce the amount of irrigation runoff at the ends of fields and to prevent excessive leaching of nutrients. Sprinklers are suitable on this soil. The rate at which water is applied should not exceed the intake rate of the soil.

This soil can be used for range, which is effective in conserving moisture and controlling erosion. Overgrazing reduces the protective cover, thus deteriorating the potential native plant community. Proper use and a planned grazing system help to maintain or improve the range condition.

This soil is fair for farmstead and feedlot windbreaks, range and livestock windbreaks, and recreation and wildlife plantings. Only drought-tolerant tree and shrub species are suited because the soil is only moderately deep over gravel and coarse sand and thus has a limited root zone. Moisture competition from grass and weeds and drought are the main hazards. Timely cultivation and adequate site preparation are needed.

This soil is fair as a site for dwellings and local roads and streets. The moderate shrink-swell potential is the main limitation. Foundations and basements should be designed so that the abutting material is replaced with the readily available coarse material of little or no clay content. The use of sewage lagoons is severely limited because of seepage into the coarse underlying material. Any nearby water supply can be contaminated by seepage from absorption fields.

Capability unit IIs-5 dryland, IIs-7 irrigated; Silty range site; windbreak suitability group 5.

Cb—Cass fine sandy loam, 0 to 2 percent slopes. This deep, nearly level soil is on bottom lands. Some areas are adjacent to meandering streams, and others are on low, flat ridges and fans near adjoining uplands. All are subject to occasional flooding. Individual areas range from 5 to 40 acres.

Typically the surface layer is very friable fine sandy loam about 12 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The transitional layer is grayish brown, very friable fine sandy loam about 14 inches thick. The underlying material is brown, loose loamy fine sand to a depth of about 38 inches and coarse sand to 60 inches. In some places the surface layer is loam.

Included with this unit in mapping are small areas of Grigston, Inavale, Leshara, and Ord soils. Grigston soils occupy positions similar to those of this Cass soil, both in drainage and elevation. Inavale soils also occupy similar positions but are generally nearer to the stream channel. Leshara and Ord soils are at lower elevations and in swales and old channels. Included soils make up about 20 percent of the total acreage.

This soil has moderately rapid permeability and moderate available water capacity. Runoff is slow. The organic-matter content is moderate, and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. It has good tilth and is easy to work.

More than two-thirds of the acreage is cultivated. The rest is in native grass.

The soil has good potential for dryland and irrigated crops, pasture and range, most windbreak plantings, and openland and rangeland wildlife habitat. It has fair potential for recreational development and poor potential for most engineering uses.

This soil is well suited to all of the dryland crops commonly grown in the county. Corn, grain sorghum, alfalfa, and small grain are commonly grown under dryland management. The droughty underlying material is a limitation, particularly during years of below normal rain-

fall. If left bare, the soil is moderately susceptible to soil blowing. A conservation tillage system, which keeps crop residue on the surface and a cover of legumes or grasses or a mixture of both, helps to replenish the supply of organic matter and control soil blowing.

Under irrigation, this soil is used mainly for corn and alfalfa. It is also suited to small grain and tame grasses. Both gravity and sprinkler irrigation are suitable. Applications of water should be light and frequent because of the coarse textured underlying material. Land leveling is needed for efficient gravity irrigation. The conservation practices needed to control erosion are the same in both irrigated and dryfarmed areas.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and timely deferment of grazing or haying help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for tree plantings in field windbreaks, in range or livestock windbreaks, and in recreation or wildlife areas. Lack of moisture and soil blowing are the principal hazards in establishing trees. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation should be restricted to the tree rows.

Flooding and seepage are severe limitations for dwellings, septic tank absorption fields, and sewage lagoons. Alternate sites at higher elevations should be selected.

This soil is suited to most recreational uses except camp areas, where flooding is a severe hazard.

Capability unit IIe-3 dryland, IIe-8 irrigated; Sandy Lowland range site; windbreak suitability group 3.

CrE2—Crofton silt loam, 11 to 15 percent slopes, eroded. This is a deep, moderately steep, well drained soil. It is on sharp ridgetops and convex hillsides of drainage divides adjacent to or within a few miles of the Missouri River Valley. Individual areas are 10 to 50 acres.

Typically the surface layer is friable, grayish brown silt loam about 6 inches thick. The transition layer is friable, grayish brown silt loam with many hard and soft lime masses. It is about 8 inches thick. The underlying material to a depth of 60 inches is pale brown to light yellowish brown silt loam. The soil is calcareous throughout.

Included with this soil in mapping are small areas of Nora soils that have a noncalcareous surface layer more than 7 inches thick. These soils are generally on lesser side slopes. Also included are some areas of steeper soils and some areas where siltstone is within a depth of 40 inches. The included soils make up 10 to 20 percent of the unit.

The available water capacity is high, and permeability is moderate. The organic-matter content is moderately low. Runoff is rapid. The shrink-swell potential is low. This soil releases moisture readily to plants. It is moderately alkaline and is low in nitrogen and available phosphorus.

Most of the acreage is cultivated. The rest is in native grass.

The soil has poor potential for row crops and fair potential for grasses and legumes. It has fair potential for trees and shrubs in windbreaks, for rangeland, for most engineering uses, and for openland wildlife habitat. It has good potential for rangeland wildlife habitat. It has poor potential for recreation.

All locally suited dryland crops can be grown on this soil. The difficulty in maintaining fertility and the severe hazard of water erosion, however, make the soil better suited to grass, mixtures of grasses and legumes, and close sown crops than to row crops. Excessive tillage should be avoided. Contour farming, terracing, grassed waterways, and a conservation system of planting row crops help to conserve moisture and to control water erosion. Crop residue use and conservation tillage also reduce the risk of erosion and improve organic-matter content. Commercial fertilizer improves fertility. Phosphorus is needed for good production of alfalfa.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing the range, however, reduces the protective plant cover, thus deteriorating the plant community. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil is suited to farmstead and feedlot windbreaks, range or livestock windbreaks, and recreation or wildlife plantings. Only tree and shrub species that are tolerant of a high calcium content or are highly drought tolerant are suited. Susceptibility to water erosion and moisture competition from grass and weeds are the principal hazards in establishing seedlings. Proper site preparation and timely cultivation between tree rows are needed.

This soil has moderate limitations for dwellings. The steepness of slope is a problem in installing septic tank absorption fields and sewage lagoons. Trench lines should be constructed approximately on the contour. These contour tile lines can be alternated back and forth down the slope at successive levels. Sewage lagoons should be located on the lower foot slopes or the less sloping ridgetops. Constructing local roads and streets on the contour reduces the erosion hazard.

Capability unit IVe-9; Limy Upland range site; windbreak suitability group 5.

DuB—Dunday loamy fine sand, 0 to 3 percent slopes. This nearly level to very gently sloping, well drained soil is in upland valleys and on broad sandy divides. Individual areas are nearly uniform in slope and range from 10 to 250 acres.

Typically the surface layer is dark grayish brown, very friable loamy fine sand about 11 inches thick. The transitional layer is dark brown, very friable loamy sand about 7 inches thick. The underlying material is brown, loose fine sand to a depth of about 24 inches and very pale brown, loose fine sand to 60 inches. In a few areas there is a loamy layer in the underlying material.

Included with this unit in mapping are small areas of Brocksburg and Simeon soils, which are slightly lower on the landscape than this Dunday soil. Also included are small areas of the slightly undulating Valentine soils. These included areas make up 10 to 15 percent of the total acreage in the unit.

This soil has moderately rapid over rapid permeability and low available water capacity. The organic-matter content is low, and the natural fertility level is low. Runoff is very slow. The reaction is slightly acid to neutral. This soil is easily worked and releases moisture readily to plants.

About half the acreage is cultivated. The rest is native rangeland.

The soil has poor potential for dryland crops and good potential for irrigated crops. It has fair potential for rangeland. It has good potential for windbreak plantings and openland and rangeland wildlife habitat. It has fair potential for recreation and most engineering uses.

This soil is suited to dryland alfalfa, tame grass, small grain, corn, and grain sorghum. It is highly susceptible to soil blowing and is droughty, even in years of normal rainfall. Because of these severe hazards, careful management is needed. The risk of soil blowing can be reduced and moisture conserved by using a cropping system that keeps the soil covered with crops, grass, or crop residue. Only a limited number of row crops should be included in the cropping sequence. Stripcropping, field windbreaks, and a conservation tillage system also can help in controlling soil blowing. Lime and phosphorous are needed for alfalfa.

Under irrigation, corn, sorghum, small grain, and alfalfa can be grown. Sprinklers are the most practical. Applications of water should be light and frequent. The conservation practices needed to control soil blowing are the same in irrigated and dryfarmed areas.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and possibly blowouts. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is well suited to tree planting if soil blowing is controlled by maintaining strips of sod or other vegetation between the rows. Drought and competition for moisture from grass and weeds are hazards. Only tree and shrub species tolerant of sandy, somewhat droughty conditions should be selected.

This soil is well suited to dwellings, septic tank absorption fields, and local roads and streets. It is poorly suited to sewage lagoons because of seepage. Sealing or lining the bottom and sides of the lagoon with impervious material is needed. Limitations are moderate for camp areas and picnic areas.

Capability unit IVe-5 dryland, IIIe-11 irrigated; Sandy range site; windbreak suitability group 3.

DuC—Dunday loamy fine sand, 3 to 6 percent slopes. This gently sloping, well drained soil is at the edges of sandy upland valleys and divides. Individual areas are 10 to 120 acres and are irregular in shape.

Typically the surface layer is dark grayish brown, very friable loamy fine sand about 15 inches thick. The transitional zone is grayish brown, very friable loamy sand about 7 inches thick. The underlying material to a depth of 60 inches is light brownish gray fine sand.

Included with this soil in mapping are small areas of Simeon and Valentine soils. Simeon soils are less sloping than this Dunday soil, and Valentine soils generally are higher on the landscape. These included areas make up 5 to 15 percent of each mapped area.

Permeability is moderately rapid in the upper layers and rapid in the lower layer. The available water capacity, organic-matter content, and natural fertility are low. Runoff is slow. The reaction is slightly acid or neutral. The soil is easily worked and releases moisture readily to plants.

About 75 percent of the acreage is in native grass and is used for range. The rest is cultivated.

The soil has poor potential for dryland crops. It has fair potential for irrigated crops, pasture, rangeland, and recreation and most engineering uses. It has good potential for windbreaks and openland and rangeland wildlife habitat.

The chief dryland crops are alfalfa, tame grass, and small grain, and to a lesser extent, corn and grain sorghum. Soil blowing is a severe hazard. The low fertility and the somewhat droughty underlying material are moderate limitations. The risk of soil blowing can be reduced and moisture conserved by using a cropping system that keeps a plant cover of crops, grass, or crop residue. Only a limited number of row crops should be included in the cropping sequence. Stripcropping, field windbreaks, and a conservation tillage system also can help in controlling soil blowing. Lime and phosphorous are needed for alfalfa.

If irrigated, this soil can be used for most crops grown in the county. Sprinkler irrigation is more practical than other methods. Center-pivot sprinklers are particularly well suited. Water application should be light and frequent. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

Range, an excellent use of this soil, is highly effective in controlling soil blowing and water erosion. Overgrazing, however, reduces the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range condition and keep the soil in good condition.

This soil generally provides good tree planting sites if soil blowing is controlled. Lack of moisture and severe soil blowing are the principal hazards. Soil blowing can be prevented by maintaining strips of sod or other vegetation between the rows. Cultivation generally should be

restricted to the tree rows. Only tree and shrub species tolerant of sandy, somewhat droughty conditions should be selected.

This soil is suited to dwellings, septic tank absorption fields, and local roads and streets. Because of the hazard of soil blowing, mulching may be needed on roadfills. The soil is poorly suited to sewage lagoons because of seepage. The rapid permeability can result in pollution of ground water. Sealing or lining the bottom and sides of the lagoon with impervious material is needed. This soil has only moderate limitations for campgrounds and picnic areas because it is too sandy.

Capability unit IVe-5 dryland, IVe-11 irrigated; Sandy range site; windbreak suitability group 3.

DuD—Dunday loamy fine sand, 6 to 11 percent slopes. This strongly sloping, somewhat excessively drained soil is in the sandy uplands. Slopes are plane or complex. Areas range from 5 to 100 acres and are irregular in shape.

Typically the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The transitional zone is about 9 inches thick. It is dark grayish brown, very friable loamy fine sand. The underlying material is brown loamy fine sand and loamy sand in the upper part and light yellowish brown fine sand to a depth of 60 inches. Reaction is slightly acid or neutral. In some places slopes exceed 11 percent.

Included with this soil in mapping are small areas of Mariaville, Simeon, and Valentine soils. The Mariaville soils are steeper than this Dunday soil and are lower on the landscape. The Simeon soils are less sloping, and the Valentine soils are generally higher on the landscape. Included soils make up 5 to 10 percent of the mapped areas.

This soil has moderately rapid permeability in the upper layers and rapid permeability in the underlying layer. The available water capacity, organic-matter content, and natural fertility are low. Runoff is slow to medium. Reaction is slightly acid or neutral. This soil releases moisture readily to plants.

Almost all the acreage is in native grass and is used for range. A few small included areas of less sloping soils are cultivated.

This soil has fair potential for rangeland and rangeland wildlife habitat. It has fair potential for pasture, windbreak plantings, and most recreation uses, poor potential for most engineering uses, and very poor potential for dryland crops.

The use of this soil as range is effective in controlling soil blowing and water erosion. Overgrazing, however, reduces the protective plant cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition. Areas that have been cultivated or are now under cultivation should be returned to native vegetation.

This soil should not be used for field windbreaks, but it is a fair site for farmstead and feedlot windbreaks, range or livestock windbreaks, and recreation and wildlife plantings. The soil is so loose that trees should be planted in shallow furrows and not cultivated. Young seedlings may be damaged by sand blasting or covered with drifting sand during high winds.

This soil has moderate limitations for dwellings and slight limitations for septic tank absorption fields and local roads and streets. Slope is the main hazard for dwellings. Shaping may be needed. Drain trenches for septic tank absorption fields should be installed on the contour to insure that effluent can be dispersed throughout the absorption area. Roadcuts and fill areas should be seeded and mulched to reduce the risk of erosion. Seepage is a severe limitation for sewage lagoons. Pollution of ground water may also be a hazard. This soil has moderate limitations for campgrounds and picnic areas because it is too sandy.

Capability unit VIe-5 dryland, IVe-11 irrigated; Sandy range site; windbreak suitability group 7.

DxB—Dunday loamy fine sand, loamy substratum, 0 to 3 percent slopes. This nearly level to very gently sloping, well drained soil occupies upland valleys and broad sandy divides. Almost all the acreage is on a geologic terrace between the Keya Paha and Niobrara Rivers. Areas range from 20 to more than 400 acres.

Typically the surface layer is very friable loamy fine sand about 14 inches thick. The upper part is dark grayish brown, and the lower part is dark brown. The transitional layer is grayish brown, very friable loamy sand about 10 inches thick. The underlying material is brown, very friable loamy fine sand to a depth of about 34 inches. Below this is a buried profile of dark brown, very friable sandy loam to a depth of about 48 inches and pale brown coarse sand and gravel to 60 inches. In a few places this buried profile is lacking. In some small areas the slope is slightly more than 3 percent.

Included with this soil in mapping are small areas of Brocksburg fine sandy loam and O'Neill, Simeon, and Valentine soils. Brocksburg, O'Neill, and Simeon soils are at slightly lower levels than this Dunday soil. Valentine soils are in higher, slightly undulating positions. These included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the lower underlying layer. The available water capacity is low. Shrink-swell potential is low. The natural fertility and organic-matter content are low. Reaction is slightly acid or neutral in the upper layers and mildly alkaline in the lower layers. The surface layer is easily tilled and absorbs and releases water readily.

Approximately half the acreage is cultivated and most of this is irrigated. The rest is native range.

This soil has poor potential for dryland crops and good potential for irrigated crops. It has fair potential for range. It has good potential for windbreak plantings and openland and rangeland wildlife habitat. It has fair potential for recreation and most engineering uses.

This soil is suited to dryland alfalfa, tame grasses, small grain, corn, and grain sorghum. It is highly susceptible to blowing. Conservation tillage, which keeps a plant cover of crops, grass, or crop residue, protects the soil from blowing. A cropping system that returns a large amount of organic matter to the soil helps to improve soil fertility. Only a limited number of row crops should be included in the cropping sequence. Stripcropping and field windbreaks can be used in controlling soil blowing. Lime and phosphorous are needed for alfalfa.

Under irrigation, corn and alfalfa are the main crops. Small grain, grain sorghum, and hay and pasture are also grown. Sprinklers are well suited. Adequate fertilizer should be applied to insure enough crop residue in controlling erosion and maintaining fertility. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

Use of this soil as range is highly effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for field windbreaks, farmstead and feedlot windbreaks, range or livestock windbreaks, and recreation and wildlife plantings. Lack of moisture and severe soil blowing are the main hazards in establishing trees. Only tree and shrub species tolerant of sandy, somewhat droughty conditions should be selected. The risk of soil blowing can be reduced by maintaining strips of sod or other vegetation between the rows. Cultivation generally should be restricted to the tree rows.

This soil is well suited as a site for dwellings, septic tank absorption fields, and local roads and streets. Sewage lagoons built in this soil will not hold wastewater long enough to allow for decomposition. To eliminate seepage, the bottom and sides of the lagoon must be sealed with impervious material. This soil provides only fair sites for recreational areas, such as camp areas, picnic areas, playgrounds, and native trails, because it is too sandy.

Capability unit IVe-5 dryland, IIIe-11 irrigated; Sandy range site; windbreak suitability group 3.

Et—Eltree silt loam, 0 to 2 percent slopes. This nearly level, deep, well drained soil is on uplands. Individual areas are 5 to 30 acres.

Typically the surface layer is friable, dark grayish brown silt loam about 25 inches thick. The subsoil is friable, grayish brown, calcareous silt loam about 13 inches thick. The underlying material is brown, calcareous silt loam to a depth of more than 60 inches. In some places, the subsoil is a light silty clay loam.

Included with this soil in mapping are small areas of Nora soils, which are slightly more sloping. These included areas make up less than 10 to 20 percent of each mapped area.

This soil has moderate permeability and high available water capacity. It releases moisture readily to plants. It has good tilth and is easily worked. The organic-matter content is moderate, and natural fertility is high. Runoff is slow. In some areas runoff from adjoining slopes drains onto this soil.

Almost all the acreage is farmed. The soil has good potential for cultivated crops. It has good potential for trees and shrubs in windbreaks. Potential is good for some engineering uses but fair for others because of the low bearing capacity.

This soil is well suited to all of the dryland crops commonly grown in the county. It is especially well suited to corn, grain sorghum, and other field crops. Row crops can be grown year after year if fertility is maintained and if weeds, plant disease, and insects are controlled. Crops on this soil respond well to additions of nitrogen fertilizer. In some years, inadequate rainfall limits crop production. This soil is also well suited to pasture and alfalfa for hay.

Conserving moisture and maintaining a high fertility level and high organic-matter content are the main concerns of management. Soil blowing is a hazard if the surface is left unprotected. A cropping system that keeps crop residue on the surface helps to control soil blowing and conserve moisture.

Under irrigation, this soil has a few restrictions. Fertility can be maintained by returning crop residue to the soil and by applying commercial fertilizer and barnyard manure. Fertilizers should be applied according to the results of soil tests. Insects and plant diseases should be controlled. Land leveling provides even distribution of irrigation water and is commonly needed for border and furrow irrigation. Sprinklers are also suitable. Application of irrigation water by sprinklers should be adjusted to the natural intake rate of the soil to prevent ponding in low areas.

This soil is well suited to all tree plantings. Suitable kinds of trees have a good chance of survival and fair growth if moisture competition from grass and weeds is eliminated and the site is properly prepared.

This soil is suited to dwellings, septic tank absorption fields, sewage lagoons, and local roads and streets. The bottoms of sewage lagoons may need sealing to prevent seepage. In constructing local roads and streets, special design is needed to overcome low strength and frost action. Replacement or modification of soil material may be needed.

Capability unit IIc-1 dryland, I-6 irrigated; Silty range site; windbreak suitability group 4.

Go—Grigston silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is generally on the higher bottom lands along the major stream channels. It generally occurs as irregularly shaped areas of 5 to 25 acres. It is subject to occasional flooding.

Typically the surface layer is friable silt loam about 15 inches thick. The upper part is dark gray and the lower part is dark grayish brown. The subsoil is grayish brown, friable silt loam about 16 inches thick. The underlying

material is brown, very friable loam to a depth of about 54 inches and pale brown, very friable fine sandy loam to 60 inches. In some places the surface layer is silty clay loam. In a few areas the coarser textured underlying material is higher in the profile.

Included with this soil in mapping are small areas of Cass, Inavale, Leshara, and Ord soils. Cass and Inavale soils are similar to this Grigston soil in depth to the water table and in location on the landscape. Leshara and Ord soils are at lower elevations. These included areas make up less than 15 percent of each mapped area.

This soil has moderate permeability. The available water capacity is high. The shrink-swell potential is low. Surface runoff is slow. Natural fertility is high, and organic-matter content is moderate. The soil has good tilth and is easily tilled. It commonly receives runoff from adjoining areas. Depth to the seasonal high water table is 6 to 10 feet.

About 75 percent of the acreage is cultivated. The areas still in grass are small, isolated tracts where farming is not practical.

This soil has good potential for dryland and irrigated crops, pasture and range, windbreak plantings, and openland and rangeland wildlife habitat. It has fair potential for recreational facilities and poor potential for most engineering uses. Potential for wetland habitat is poor.

This soil is well suited to most of the dryland crops grown in the county. It is especially well suited to such row crops as corn and grain sorghum. Close sown crops, such as small grain, alfalfa, and tame grasses, are also suitable. Flooding or overflow can be a hazard some years, but crop losses are generally minor. Maintaining fertility and the supply of organic matter are the main concerns in management. Fertility can be maintained by returning crop residue to the soil during tillage. Maintaining crop residue on the surface increases water intake and reduces evaporation. An intensive cropping system that has a high percentage of row crops can be used if diseases and insects are controlled. Legumes and grasses in the cropping system improve tilth and help to break disease and insect cycles. Grassed waterways and diversions are needed to remove the excess water.

Under irrigation, this soil has few limitations. At times, runoff from adjacent uplands is a slight limitation, and there is some hazard of flooding. If border or furrow irrigation is used, land leveling is needed to provide even distribution of irrigation water, to allow uniform drainage, and to reduce the hazard of erosion. Sprinkler irrigation is also suitable. The cropping systems and fertility management practices needed are the same in both irrigated and dryfarmed areas.

Use of this soil as range is highly effective in controlling erosion. The protective cover of the potential native plant community, however, can be reduced by overgrazing or improper haying methods. Proper use and timely deferment of grazing or haying help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good tree planting sites. Survival and growth of suitable species is good. Moisture competition from weeds and grasses is the main limitation. All tree and shrub species climatically adapted are suitable in field, feedlot, and livestock protection windbreaks and as recreation and wildlife plantings.

Flooding is a severe limitation for dwellings, septic tank absorption fields, and sewage lagoons. Alternate sites at higher elevations should be selected. For local roads, replacement or modification of subgrade material is needed to overcome low strength. Fill areas must be built up to protect from flooding.

Capability unit IIw-3 dryland, IIw-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

GrB—Grigston silt loam, channeled, 0 to 3 percent slopes. This deep, well drained soil is on flood plains that are subject to frequent flooding. Areas are long and narrow and are dissected by channels that meander back and forth across the flood plain. The channels are 30 to 70 feet wide and 5 to 20 feet deep. Slopes are mainly less than 3 percent but are as much as 5 percent on some narrow benches and streambanks. Areas range from 5 to 40 acres.

Typically the surface layer is friable silt loam about 14 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The subsoil is grayish brown, friable silt loam about 16 inches thick. The underlying material is grayish brown, stratified sandy loam and silt loam to a depth of about 40 inches and pale brown fine sand to 60 inches. Some strata have strong bedding planes. In some there are sandy or clayey sediments.

Included with this unit in mapping are small areas of Barney, Inavale, and Leshara soils. Barney soils are at lower elevations than this Grigston soil, generally nearer the stream channels. Inavale soils occupy positions similar to those of the Grigston soil. Leshara soils are in intermediate positions between Barney and Grigston soils. The included soils make up 10 to 20 percent of the mapped area.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. Natural fertility is high, and the organic-matter content is moderate. The seasonal high water table is usually below a depth of 6 feet.

Almost all the acreage is rangeland that has been invaded by woody plants. The soil has very poor potential for cultivated crops, windbreak plantings, most recreational development, and engineering uses. It has good potential for pasture and range grasses where the tree and shrub growth has been cleared or is sparse. Potential is good for rangeland wildlife habitat.

Frequent overflow, streambank cutting, and channel changes make this soil unsuitable for cultivation. Most areas are used for grazing. Use of this soil as range is highly effective in controlling water erosion and soil blowing. Overgrazing and silt deposition, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and a planned grazing

system help to maintain or improve the range and keep the soil in good condition.

Areas that support mostly trees, woody shrubs, and annual weeds are also common on this soil. They provide good cover and habitat for many kinds of wildlife.

This soil is not suited to windbreak plantings of any kind because of unfavorable qualities and characteristics. Some areas can be used for wildlife or forestation plantings if tolerant tree or shrub species are hand planted.

This soil is not suited as a site for dwellings or any onsite sewage disposal systems. Access roads and fences are commonly damaged by channel changes and streambank cutting. Where roads must cross areas of this soil, special structures are generally needed. In some places pond reservoirs can be constructed.

Capability unit VIw-7; Silty Overflow range site; windbreak suitability group 10.

Ha—Hall silt loam, 0 to 2 percent slopes. This nearly level, well drained soil is on stream terraces. Individual areas range from 5 to 60 acres.

Typically, the surface layer is about 18 inches thick. The plowed layer is dark grayish brown, very friable silt loam, and the lower layer is very dark grayish brown, friable silty clay loam. The subsoil is friable silty clay loam about 24 inches thick. It is dark grayish brown in the upper part, brown in the middle part, and yellowish brown in the lower part. The underlying material is pale brown, firm silty clay loam to a depth of 60 inches. In places the surface layer is silty clay loam, and in some areas the subsoil has a slightly higher than normal clay content. In some areas the lower part of the underlying material is coarser textured.

Included with this soil in mapping are small areas of Blendon and Verdel soils. The Blendon soils are in positions similar to those of this Hall soil but are generally nearer the stream channel. The Verdel soils generally occur at slightly higher elevations and are nearer the uplands. These included soils make up 5 to 15 percent of each mapped area.

This soil has moderately slow permeability and high available water capacity. Runoff is slow. The shrink-swell potential is moderate. The organic-matter content is moderate, and the natural fertility level is high. The soil absorbs water well and releases it readily to plants. It generally has good tilth and is easily worked.

Most of the acreage is in cultivated crops, and the rest is mainly in native grass. There are a few small wooded areas.

The soil has good potential for the commonly grown dryland and irrigated cultivated crops. It has good potential for pasture and range, trees, openland and rangeland wildlife habitat, and recreational uses. It has fair potential for most engineering uses.

This soil is well suited to dryland corn, grain sorghum, alfalfa, small grain, and grasses. Inadequate rainfall limits crop production. On the lower stream terraces, alfalfa can obtain some moisture from the ground water table. This soil also receives some run-in water from surrounding uplands. Conserving moisture and maintaining the organic-matter content and high fertility level are the principal concerns in management. Soil blowing can be a hazard in unprotected areas. A conservation tillage system of planting row crops and returning crop residue protects the soil from blowing. Commercial fertilizer and a cropping system that includes grasses and legumes help to increase the organic-matter content and maintain fertility.

Under irrigation, this soil has few limitations. It is suited to most of the irrigated crops grown in the county. Corn is the main crop. Suitable irrigation systems include borders, furrows, and sprinklers. Land leveling is needed for satisfactory operation of border and furrow systems. The application rate should be adjusted to the intake rate of the soil. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is well suited to field, farmstead and feedlot, and livestock protection windbreaks and to recreation and wildlife plantings. All trees and shrubs climatically adapted are suited. Moisture competition from grass and weeds is the main concern in establishing and managing trees.

Limitations are moderate for dwellings because of shrink-swell action. It may be possible to replace the soil material abutting foundations and basement walls with material of low clay content having low shrink-swell properties. There are no special problems for shallow excavations in this soil. Low strength is a moderate limitation for local roads and streets. Replacement or modification of the subgrade soil material may be needed. Some septic tank absorption fields require larger than normal absorption areas because of slow percolation. There are moderate limitations for sewage lagoons because of seepage. It may be necessary to seal the bottom and sides of the lagoon with more impervious material.

Capability unit IIc-1 dryland, I-4 irrigated; Silty Lowland range site; windbreak suitability group 1.

He—Haynie silt loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on bottom lands of the Missouri River Valley. Areas are long and narrow and roughly parallel the river channel. Some areas are flooded occasionally when water runs in from adjoining land. Flooding caused by the river overflow has been largely eliminated since construction of the large dams. Areas range from 5 to 150 acres.

Typically the surface layer is very friable, grayish brown silt loam about 7 inches thick. The underlying material is very friable, grayish brown silt loam to a depth of 18 inches, stratified, light grayish brown very

fine sandy loam and light gray silt loam to 46 inches; and grayish brown fine sand to 60 inches. In some places the depth to the fine sand underlying material is less than 46 inches. In some small areas sand occurs near the surface.

Included with this soil in mapping are small areas of Blake, Inavale, and Onawa soils. Blake and Onawa soils occur at slightly lower elevations than this Haynie soil. Inavale soils occur at similar levels. The included soils make up 10 to 15 percent of the total acreage.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderately low, and the natural fertility level is medium. The soil absorbs moisture easily and releases it readily to plants. It is easy to work. Runoff is slow. The shrink-swell potential is low. The seasonal high water table is generally below a depth of 6 feet.

Most of the acreage is in cultivated crops. A few small areas next to the river or on islands in the river support trees and grass. These areas are used for range or as habitat for wildlife.

This soil has good potential for dryland and irrigated crops, pasture and range, windbreak plantings, and openland and woodland wildlife habitat. It has fair potential for recreation and poor potential for most engineering uses.

This soil is well suited to all of the dryland crops commonly grown in the county. It is especially suited to corn, soybeans, grain sorghum, and other field crops. In most years natural rainfall is adequate for crop needs. Row crops can be grown year after year if proper amounts of fertilizer are used and if weeds, plant disease, and insects are controlled. Crops on this soil respond well to nitrogen fertilizer. The soil is also well suited to pasture. Grassed waterways are needed to carry runoff. In places, diversion ditches help to intercept runoff from adjacent higher areas. Conservation tillage, which leaves crop residue on the surface, helps to control soil blowing and conserve moisture in areas that are cultivated year after year. A cropping system that returns a large amount of organic matter to the soil helps to improve soil structure and increase water intake.

All crops commonly grown in the county are suited to irrigation. Corn and alfalfa are the main crops. Grain sorghum and tame grasses are also grown. The soil has few restrictions under irrigation. The conservation and cultural practices needed to control erosion are the same in irrigated and dryfarmed areas.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and timely deferment of grazing or haying help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for tree planting in field, farmstead, feedlot, and livestock protection windbreaks and in recreation and wildlife areas. Survival and growth of trees is good. Competition for moisture from weeds and grass is the principal hazard in establishing and managing trees. All tree and shrub species climatically adapted are suited.

This soil has few restrictions for dwellings and septic tank filter fields except in areas that are occasionally flooded. Areas where flooding is a hazard should be protected or alternate sites should be considered. Limitations are moderate for sewage lagoons because of seepage. Sealing the bottom and sides of lagoons may be needed. Roads built on this soil should be protected from occasional flooding. Elevated roadbeds and side ditches should be constructed to remove floodwater. Replacing base material of roads provides a moisture barrier against frost action. Recreational areas, such as camp grounds, picnic areas, playgrounds, and nature trails, are suited to this soil except in areas where flooding is a hazard.

Capability unit I-1 dryland, I-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

IfD—Inavale fine sand, 3 to 11 percent slopes. This deep, somewhat excessively drained soil is on bottom lands along all major streams in the county, where the sandy alluvial material has been reworked by wind action. It occurs as long, narrow, hummocky ridges that are 15 to 30 feet higher than the adjacent soils and are generally parallel to the streams. It is rarely flooded. Individual areas range from about 5 to 60 acres.

Typically the surface layer is dark grayish brown, loose fine sand about 6 inches thick. The transition layer is about 6 inches of grayish brown fine sand. The underlying material is pale brown fine sand to 60 inches. In some places, the surface layer is loamy sand. In a few areas the soil is moderately alkaline.

Included with this soil in mapping are small areas of Cass, Grigston, and Ord soils. Cass and Grigston soils are generally nearly level and are lower on the landscape than this Inavale soil. Ord soils are somewhat poorly drained and are lower on the landscape. The included areas make up 5 to 15 percent of each mapped area.

Permeability is rapid, and available water capacity is low. Runoff is slow. Most of the rainfall is absorbed as rapidly as it falls. The organic-matter content and natural fertility are low. The soil takes in water easily and releases it readily to plants. The seasonal high water table is below a depth of 6 feet.

Most areas are in native rangeland with some sparse tree cover. Small areas, mostly those associated with finer textured soils on lesser slopes, are cultivated.

This soil has very poor potential for crops and poor potential for recreation. It has fair potential for pasture, range, trees, rangeland wildlife habitat, and most engineering uses.

The soil is well suited to native grasses. Using it as range is highly effective in controlling soil blowing and water erosion. Overgrazing reduces the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is not suited to cultivated crops. It is susceptible to soil blowing and water erosion in cultivated areas because it is sandy and slopes are gentle to strong.

This soil generally is not well suited to field windbreaks, but it provides a fair site for feedlot, range, or livestock windbreaks and for recreation and wildlife plantings. The soil is so loose that trees should be planted in shallow furrows and not cultivated. Young seedlings can be damaged by sand blasting or covered with drifting sand during high winds.

Limitations are severe for dwellings. Dwellings in the lower areas are subject to flooding. Alternate sites should be considered. The soil is suited to septic tank filter fields if they are located above flood areas. It is not suited to sewage lagoons unless the sides and bottom are sealed or lined to prevent seepage. It is suited to local roads and streets. Exposed slopes of roadcuts are subject to erosion. Occasional flooding is a hazard at the lower elevations of the unit, and minimum fills are required. This soil provides good subgrade material for surfaced roads but poor material for unsurfaced roads.

Capability unit VIe-5; Sands range site; windbreak suitability group 7.

IgB—Inavale fine sand, channeled, 0 to 3 percent slopes. This deep, somewhat excessively drained soil is on flood plains that are subject to frequent flooding. The flooding commonly occurs each spring, but it can also occur at other times. Areas of this soil are long and narrow and are dissected by old creek beds, sloughs, and channels that meander through the flood plains. The channels are 40 to 70 feet wide and 4 to 20 feet deep. Slopes are mainly less than 2 percent but are as much as 5 percent on some narrow benches, on streambanks, and in some gullied areas. Individual areas of this soil range from 5 to 100 acres.

Typically the surface layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is light brownish gray, loose fine sand to a depth of about 16 inches and light gray fine sand and sand to 60 inches. In some places the surface layer is loamy sand and in others it is sandy loam. Some small areas are a similar soil that has a water table within 2 to 6 feet.

Included with this soil in mapping are small areas of Barney and Cass soils. Cass soils are at higher elevations than this Inavale soil. Barney soils generally occupy the lowest elevations on the landscape. Included soils make up 5 to 15 percent of the mapped areas.

Permeability is rapid, and the available water capacity is low. Water intake is rapid, and runoff is slow. The organic-matter content is low.

All the acreage is used for range. The soil has good potential for pasture, range, and rangeland wildlife habitat. It has very poor potential for crops and trees and poor potential for most engineering uses.

This soil is not suitable for cultivation. Wetness caused by frequent flooding is a hazard. Erosion is a hazard because of the scouring action of floodwater and because of soil blowing in bare areas.

This soil is best suited to grass or trees. Flooded areas that lack adequate cover can be reseeded to grass for grazing. The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing, however, reduces the protective cover, thus deteriorating the potential native plant community. Proper use and timely deferment of grazing help to maintain or improve the range and keep the soil in good condition.

This soil is not generally suited to windbreak plantings because of its unfavorable qualities and characteristics. Some areas can be used for recreation, wildlife, and forestation plantings if tolerant tree or shrub species are hand planted or other special approved practices are used.

Wooded or brushy areas that are not used for grazing provide excellent habitat for wildlife.

Limitations are severe on this soil for dwellings, septic tank absorption fields, and sewage lagoons because of excessive seepage and frequent flooding. Alternate sites at higher elevations should be selected. Unless protected by diversions, storm sewers, or drainage ditches, local roads should not be located on this soil because of frequent flooding.

Capability unit VIw-7; Sandy Lowland range site; windbreak suitability group 10.

IhB—Inavale loamy fine sand, 0 to 3 percent slopes. This nearly level, deep, somewhat excessively drained soil is on bottom lands along the major streams. It is occasionally flooded. Areas are long and narrow and are commonly adjacent to the stream channels. Individual areas are 5 to 80 acres.

Typically the surface layer is grayish brown, very friable loamy fine sand about 9 inches thick. The transition layer is grayish brown, loose loamy sand about 10 inches thick. The underlying material is very pale brown fine sand to a depth of 60 inches. In some places the surface layer is loamy sand or fine sandy loam, and in others it is darker colored than is typical.

Included with this unit in mapping are small areas of Cass, Ord, and Grigston soils. Cass soils are generally slightly higher on the landscape and are commonly farther from the stream channels than this Inavale soil. Grigston soils are generally at higher elevations. Ord soils are at lower elevations. The included soils make up 5 to 15 percent of the total acreage in the unit.

Permeability is rapid, and the available water capacity is low. Runoff is slow. The soil absorbs moisture rapidly and releases it readily to plants. The organic-matter content is low, and natural fertility is low.

Most of the acreage is in native grass. Cultivated areas are mainly the larger areas or the areas near finer textured soils. The soil has good potential for pasture and rangeland grasses, windbreak tree planting, and rangeland wildlife habitat. It has poor potential for dryland crops and fair potential for irrigated crops and openland wildlife habitat. Potential is fair for recreational uses and poor for most engineering uses.

This soil is used mainly for range. Range and pasture, both excellent uses, are highly effective in controlling soil

blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and timely deferment of grazing or haying help to maintain or improve the range and keep the soil in good condition.

This soil is marginal for dryland row crops. Such close-growing crops as alfalfa, grass, and small grain are better suited than other crops. Soil blowing is a moderate to severe hazard in cultivated areas. Low fertility and the somewhat droughty underlying material are moderate limitations. The soil is commonly too loose to be easy to work. Where row crops are planted, narrow strips or fields can be alternated with close-sown crops. A conservation cropping system, which leaves crop residue on the surface, protects the soil from soil blowing and conserves moisture. Narrow plantings of trees in windbreaks also help to reduce soil blowing.

Under irrigation, corn and alfalfa are the main crops. Close-sown crops, such as small grain, hay, and pasture grasses, are also suited. Sprinkler irrigation is well suited to this soil. The conservation practices needed to control erosion are the same under sprinkler irrigation and dryland management.

This soil is well suited to field windbreaks, feedlot windbreaks, and range or livestock windbreaks and to recreation and wildlife plantings. Only tree and shrub species tolerant of sandy, somewhat droughty conditions are suited. Lack of moisture and severe soil blowing are the principal hazards in establishing trees. The risk of soil blowing can be reduced by maintaining strips of sod or other vegetation between the rows.

Occasional flooding or seepage are severe limitations for dwellings, septic tank absorption fields, and sewage lagoons. Alternate sites at higher elevations should be selected. Local roads and streets are subject to erosion of cut slopes. Flooding is a hazard, and minimum fills are required. This soil provides good subgrade material for surfaced roads and poor material for unsurfaced roads.

Capability unit IVe-5 dryland, IIIe-11 irrigated; Sandy Lowland range site; windbreak suitability group 3.

In—Inavale fine sandy loam, 0 to 2 percent slopes. This deep, somewhat excessively drained soil is on bottom lands along the major streams. It is occasionally flooded. It occupies long tracts that are dissected by a few shallow channels. Slopes are plane or slightly convex. Individual areas range from 5 to 80 acres.

Typically the surface layer is grayish brown, very friable fine sandy loam about 6 inches thick. The transitional layer is light brownish gray, very friable fine sandy loam. The underlying material is loose fine sand. It is light brownish gray to a depth of 26 inches and light gray to 60 inches. In some places the surface layer is loam.

Included with this soil in mapping are small areas of Grigston and Ord soils. Grigston soils, generally at slightly higher elevations than this Inavale soil, are farther from the stream channel. Ord soils are at lower elevations in channels and swales. The included soils make up 10 to 15 percent of the total mapped acreage.

Permeability is rapid, and available water capacity is low. Runoff is slow. The organic-matter content is low, and natural fertility is low. The soil absorbs moisture rapidly and releases it readily to plants.

A few areas of this soil are cultivated, but most of the acreage is in native grass and trees and is used for range and hayland. The cropped areas are mainly the larger tracts.

This soil has good potential for pasture and range, windbreak plantings, and rangeland wildlife habitat. It has fair potential for dryland crops, openland wildlife habitat, and recreational uses. Potential is fair to good for irrigated crops. It is poor for most engineering uses.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community. Proper use and timely deferment of grazing or haying help to maintain or improve the range and keep the soil in good condition.

This soil is suited to dryland corn, small grain, grain sorghum, alfalfa, and tame grasses. It is droughty, and soil blowing is a severe hazard. A conservation tillage system, which leaves crop residue on the surface, in combination with a cropping system that includes legumes or a grass-legume mixture increases the organic-matter content, maintains productivity, and controls soil blowing. Stripcropping and field shelterbelts also help in controlling soil blowing.

Under irrigation, corn and alfalfa are the main crops. Close-sown crops, such as small grain, hay, and pasture grasses, are also suited. Soil blowing is a major hazard. Low fertility is a moderate limitation and a concern in management. This soil is easy to work. Sprinkler irrigation is well suited. Adequate fertilizer should be applied to insure production of enough crop residue for controlling erosion and maintaining fertility. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

This soil is well suited to planting field and livestock windbreaks and to recreation and wildlife plantings. Only tree and shrub species tolerant of slightly sandy, somewhat droughty conditions are suited. Lack of moisture and severe soil blowing are the principal hazards in establishing trees. The risk of soil blowing can be reduced by maintaining strips of sod or other vegetation between the rows.

Occasional flooding is a severe limitation for building sites, septic tank absorption fields, and sewage lagoons. Alternate sites at higher elevations should be selected. Minimum fills are required to prevent flooding on local roads. The subgrade material is good for surfaced roads but poor for unsurfaced roads.

Picnic areas, playgrounds, and nature trails are suited to this soil. Because flooding is a danger, campgrounds should be located in higher areas.

Capability unit IIIe-3 dryland, IIIe-11 irrigated; Sandy Lowland range site; windbreak suitability group 3.

Jn—Jansen loam, 0 to 2 percent slopes. This nearly level, well drained soil is moderately deep over sand and gravel. It is on upland tablelands. Areas are irregular in shape and range from 20 to 140 acres.

Typically the surface layer is about 10 inches thick. The plowed layer, about 6 inches thick, is dark grayish brown, friable loam. The next layer is a dark grayish brown, friable light clay loam. The subsoil is about 14 inches thick. It is brown clay loam in the upper part and sandy clay loam in the lower part. The underlying material is very pale brown gravelly coarse sand to about 37 inches and coarse sand and sand to 60 inches. In some areas the surface layer is thicker than 20 inches. In some areas the subsoil has less clay than is typical.

Included with this soil in mapping are small areas of Dunday and Simeon soils. Dunday soils occur slightly higher on the landscape than this Jansen soil. Simeon soils occur in positions similar to those of the Jansen soils. The included areas make up 5 to 15 percent of the unit.

Permeability is moderate through the subsoil and very rapid through the underlying material. Surface runoff is slow. The available water capacity is moderate. The shrink-swell potential is low in the surface layer, moderate in the subsoil, and very low in the underlying material. The organic-matter content is moderately low, and natural fertility is medium. Root penetration is mainly restricted by the underlying gravelly coarse sand.

About two-thirds of the acreage is cultivated, and the rest is mainly native range. Most of the cultivated acreage is under irrigation.

The soil has fair potential for the commonly grown cultivated dryland crops and for pasture, range, and trees. It also has fair potential for openland and rangeland wildlife habitat and for most engineering uses. It has good potential for irrigated crops and for recreational facilities.

This soil is used for dryland corn, grain sorghum, small grain, and alfalfa. Oats and grain sorghum are the most dependable dryland crops. Alfalfa generally produces a good first cutting. Lack of adequate seasonal rainfall is the main limitation. Soil blowing is a slight hazard in winter and early in spring. A cropping system that provides crop residue can be of value in conserving soil moisture.

If irrigated, this soil can be used for corn, grain sorghum, alfalfa, and tame grasses. Most kinds of irrigation commonly used in the county are suited. Some land leveling is needed for uniform distribution of water if gravity irrigation is used. Sprinklers are well suited. The irrigation water should be applied in sufficient amounts to serve the needs of the crop. Excess amounts saturate the soil and force water and nutrients into the gravelly substrata.

This soil can be used for range, which is effective in conserving moisture and controlling erosion. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil generally provides only fair sites for planting trees. It is only moderately deep over gravelly coarse sand and it lacks adequate moisture. Only trees that tolerate drought should be selected. Timely cultivation and adequate site preparation are needed to control grass and weed competition.

This soil is only fair as a site for dwellings and local roads. The moderate shrink-swell potential is the main limitation. Foundations and basements should be designed so that abutting material is replaced with readily available coarse material of little or no clay content. The use of sewage lagoons is severely limited because of seepage into the coarse underlying material. The bottom and sides of the lagoon should be sealed or lined to prevent seepage. Seepage from absorption fields can contaminate nearby water supplies.

Capability unit IIs-5 dryland, IIs-7 irrigated; Silty range site; windbreak suitability group 5.

JnC—Jansen loam, 2 to 6 percent slopes. This gently sloping, well drained soil is moderately deep over sand and gravel. It is on uplands along low ridges and on side slopes of intermittent drainageways. Areas are 10 to 150 acres.

Typically the surface layer is 9 inches thick. The upper 5 inches of the plow layer is dark gray, very friable loam. From 5 to 9 inches it is dark grayish brown, friable loam. The subsoil is about 23 inches thick. The upper part is dark brown, firm loam. The middle part is brown, firm clay loam. The lower part is yellowish brown, firm clay loam. The underlying material to a depth of 60 inches is pale brown gravelly coarse sand. In a few areas the surface layer is silt loam. In some areas it is more than 20 inches thick.

Included with this soil in mapping are areas of Meadin and O'Neill soils. These soils are lower on the landscape than this Jansen soil. They make up 5 to 10 percent of each mapped area.

Permeability is moderate through the subsoil and very rapid through the underlying material. Surface runoff is medium. The available water capacity is moderate. The shrink-swell potential is low in the surface soil, moderate in the subsoil, and very low in the underlying material. The organic-matter content is moderately low, and natural fertility is medium. Root penetration is mainly restricted by the underlying gravelly coarse sand.

About 80 percent of the acreage is cultivated. The rest is mainly in grass.

This soil has fair potential for the commonly grown cultivated crops; for pasture, range, and trees; and for openland and rangeland wildlife habitat, recreational facilities, and most engineering uses.

This soil is used for dryland corn, grain sorghum, oats, alfalfa, and grasses. It is subject to droughtiness because it is only moderately deep over sand and gravel. It is also subject to water erosion and soil blowing. Terraces, grassed waterways, contour farming, and crop residue left on the surface reduce runoff and the risk of erosion. Moisture can be conserved and the risk of soil blowing reduced through the use of a cropping system that keeps the soil covered with crops or residue most of the time.

Such a cropping system also helps to control water erosion.

If irrigated, this soil can be used for alfalfa and grasses. If erosion control is provided, the soil can be used for corn and grain sorghum. Sprinklers are the most suitable in irrigating this soil. Because of the slope, controlling the erosion resulting from irrigation is difficult. The rate of water application should not exceed the intake rate of the soil. Furrows and borders are not generally used because intensive land leveling can expose the coarse textured underlying material.

The use of this soil as pasture and range is effective in controlling erosion. Overgrazing, however, reduces the protective cover, thus deteriorating the plant community. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil provides only fair sites for planting trees. The potential survival and growth of suitable species are limited by the moderate depth over gravel, which makes this soil droughty. Lack of adequate moisture and competition for moisture from weeds and grasses are the principal hazards. Erosion is a hazard if cultivation is used to control weeds. Only trees that tolerate drought should be selected.

This soil is only fair as a site for buildings and local roads. The moderate shrink-swell potential and the slope are the main limitations. Foundations and basements should be designed so that the abutting soil material is replaced with readily available coarse material of little clay content. The use of sewage lagoons is severely limited because of the seepage. The bottom and sides of the lagoon should be sealed or lined to prevent seepage. Seepage from absorption fields can contaminate nearby water supplies.

Capability unit IIIe-1 dryland, IIIe-7 irrigated; Silty range site; windbreak suitability group 5.

JnD—Jansen loam, 6 to 11 percent slopes. This strongly sloping, well drained soil is moderately deep over sand and gravel. It is on uplands and on side slopes of drainageways. Areas are 5 to 75 acres.

Typically the surface layer is about 9 inches thick. The upper part is dark grayish brown, very friable loam, and the lower part is dark brown, very friable silt loam. The subsoil is about 19 inches thick. The upper part is dark yellowish brown, firm clay loam, and the lower part is yellowish brown, firm sandy clay loam. The underlying material is very pale brown gravelly sand to a depth of 60 inches.

Included with this soil in mapping are areas of Meadin, O'Neill, and Paka soils. The Meadin soils are lower on the landscape than the Jansen soil, and the O'Neill soils are lower than the Meadin soils. Paka soils are lowest on the landscape. Included soils make up 10 to 20 percent of the mapped areas.

Permeability is moderate through the subsoil and very rapid in the underlying material. Surface runoff is medium. The available water capacity is moderate. The shrink-swell potential is low in the surface layer, moderate in the subsoil, and very low in the underlying material. The organic-matter content is moderately low, and fertility is medium. Root penetration is mainly restricted by the underlying gravelly sand.

About 60 percent of the acreage is in cultivated crops. The rest is in native grass.

The soil has poor potential for cultivated crops. It has fair potential for trees, tame pasture, range, openland and rangeland wildlife, and recreational uses. It also has only fair potential for most engineering uses.

This soil can be used for dryland small grain, alfalfa, and tame grasses. Water erosion is the principal hazard in cultivated areas. Contour farming and tillage that leaves crop residue reduce runoff and erosion and help to increase soil moisture.

Terraces are not suitable on this soil because construction is likely to expose the sand and gravel underlying material.

Sprinkler irrigation is better suited than gravity irrigation. Alfalfa, close sown crops, and tame grasses can be grown under irrigation. Row crops are subject to erosion. The conservation and cultural practices needed to control erosion are the same in irrigated and dryfarmed areas. Under irrigation, a high level of fertility is needed to maintain high yields.

The use of this soil as range and pasture is highly effective in controlling erosion. Overgrazing, however, reduces the protective cover, thus deteriorating the plant community. Proper use and a planned grazing system help to maintain or improve the range condition. Cool and warm season grasses can be seeded to establish pasture and range on cultivated land. Cool season grasses, where managed separately from native or warm season grasses, can provide season-long green grazing for livestock. Cover crops can be used to prepare the land before seeding grasses. Such crops reduce the risk of erosion and eliminate competition from weeds.

This soil provides only fair sites for farmstead and windbreak plantings. Only the tree and shrub species that tolerate drought are suited. The susceptibility to water erosion, the competition for moisture from grass and weeds, and the droughtiness are the principal hazards in establishing seedlings.

This soil is only fair as a site for dwellings. The moderate shrink-swell potential and the slope are the main limitations. Foundations and basements should be designed so that abutting soil material is replaced with readily available coarse material of little clay content. Limitations for sewage lagoons are severe because of seepage and slope. The bottom and sides of the lagoon should be sealed or lined to prevent seepage. Cuts and fills can modify slope. Seepage from absorption fields can contaminate nearby water supplies.

Capability unit IVe-1 dryland, IVe-7 irrigated; Silty range site; windbreak suitability group 5.

LaD—Labu silty clay, 6 to 11 percent slopes. This moderately deep, well drained, strongly sloping soil is on convex ridgetops and lower side slopes of the uplands. Individual areas are 20 to 100 acres.

Typically the surface layer is firm, dark grayish brown silty clay about 5 inches thick. It ranges from 4 to 6 inches in thickness in most areas. The subsoil is about 14 inches thick. It is firm, grayish brown silty clay in the upper part and grayish brown, very firm clay in the lower part. The underlying material, about 9 inches thick, is light olive brown clay. Light yellowish brown bedded shale is at a depth of 28 inches. In some places the soil has a thick dark surface layer.

Included with this soil in mapping and making up as much as 15 percent of the unit are small areas of the deep Promise soils and the shallow Sansarc soils. Promise soils are on lower foot slopes. Sansarc soils are on narrow convex ridges and sharp slope breaks.

This soil has poor tilth and slow permeability. It takes in water slowly and releases it slowly to plants. Runoff is medium or rapid, and available water capacity is low. The shrink-swell potential is high. The organic-matter content is moderately low, and natural fertility is low. Root development is restricted by the bedded shale below a depth of about 28 inches.

The acreage of this soil is about equally divided between cropland and rangeland. The soil has poor potential for farming and fair potential for range. It has poor potential for most engineering uses and for windbreak plantings.

This soil is suited to dryland oats, barley, sorghum, and alfalfa for hay. It is poorly suited to irrigated crops because of the fine texture and moderate slopes. If it is used for cultivated crops, water erosion is a hazard. Terracing, conservation tillage, contour farming, and use of crop residue help to control erosion. Grass cover helps to reduce the risk of erosion in natural drainageways. Growing grasses and legumes in the cropping system about half the time improves tilth and organic-matter content.

This soil is suited to range. Management that maintains an adequate cover of native vegetation is needed to control erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system help to keep the range in good condition.

This soil is not suited to field windbreaks, but it is fairly well suited to farmstead and livestock windbreaks. Growth of trees and shrubs is poor because of the high clay content. Tree and shrub species selected should be limited to those that are extremely drought tolerant.

If dwellings are constructed on these soils, foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. The underlying shale beds are soft and unstable because of slippage. Artificial drainage should be provided around the buildings to avoid saturation of the soils and shales. Local roads can be graded to shed water. Suitable base material should be hauled in from outside the area.

These soils are poorly suited to septic tank absorption fields and sewage lagoons because of the moderate depth over bedrock, the slow permeability, and the slope. Deeper, less sloping sites can be found on the foot slopes or the broader ridgetops.

Capability unit IVe-4; Clayey range site; windbreak suitability group 9.

LcF—Labu-Sansarc silty clays, 11 to 30 percent slopes. This map unit consists of well drained, moderately steep to steep soils on upland ridges and side slopes. Most areas are dissected by shallow drainageways. Areas range from 60 to 400 acres. Labu soils make up 40 to 55 percent of this complex, and Sansarc soils 20 to 30 percent. Labu soils are on the longer, smoother side slopes, and Sansarc soils are on the shorter, steeper side slopes of ridges and on the shoulders of drainageways. Areas of the two soils are so intricately mixed that it is not practical to map them separately at the scale of mapping selected.

Typically the Labu soil has a dark grayish brown, firm silty clay surface layer about 6 inches thick. The subsoil is about 20 inches thick. The upper part is grayish brown, firm silty clay, and the lower part is light brownish gray, firm silty clay. Light yellowish brown bedded shale is at a depth of 34 inches. In some places the soil has a thick dark surface layer.

Typically the Sansarc soil has a firm, dark grayish brown silty clay surface layer about 5 inches thick. The underlying material is about 9 inches thick. The upper part is light brownish gray, very firm shaly clay, and the lower part is light yellowish brown, very firm shaly clay. Light brownish gray bedded shale is at a depth of about 14 inches.

Included with these soils are small areas of Promise soils and shale outcrop. The included areas make up 10 to 15 percent of the unit. The Promise soils are on the lower concave foot slopes and along drainageways. The shale outcrop is on ridges.

Permeability is slow in both Labu and Sansarc soils. The available water capacity is low in the Labu soil and very low in the Sansarc soil. Runoff is medium to rapid on the Labu soil and very rapid on the Sansarc soil. Both soils have a fine, plastic clay that holds some of the soil moisture under so much tension that it cannot be extracted by plant roots. Both soils shrink and swell markedly upon wetting and drying. Cracks 1 to 3 inches wide form as they dry. Reaction is moderately alkaline throughout both soils. The root zone extends to bedded shale.

Almost all the acreage of this complex is in native grass and is used for grazing. These soils have fair potential for range and rangeland wildlife. They have very poor potential for farming and poor potential for tree and shrub plantings and most engineering uses.

This unit is best suited to range. The soils are subject to water erosion if the vegetation is destroyed or allowed to deteriorate into poor condition. Gullies form readily. The low available water capacity and rapid runoff make these soils droughty. Maintaining an adequate plant cover helps to prevent excessive soil losses and improves the moisture supplying capacity by reducing runoff. Overstocking and overgrazing the range reduce the protective cover and deteriorate the plant community. Proper stocking rates, uniform grazing distribution,

deferred grazing, and a planned grazing system help to keep the range in good condition (fig. 11). Potential pond reservoir sites are plentiful on these soils.

If buildings are constructed on these soils, foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. The unstable underlying bedded shale can cause slippage during wet seasons. Artificial drainage should be provided around the buildings so that the soils do not become saturated.

These soils are generally not suited to septic tank absorption fields. Sewage lagoons can be used for onsite waste disposal if suitable sites can be found on deeper, less sloping soils of the foot slopes or the broader ridgetops.

Capability unit VIe-4; Labu soil in Clayey range site, Sansarc soil in Shallow Clay range site; windbreak suitability group 10.

Le—Leshara silt loam, 0 to 2 percent slopes. This somewhat poorly drained, nearly level, silty soil is on bottom lands. It is subject to occasional flooding. Individual areas are generally long and narrow and range from 5 to about 40 acres.

Typically the surface layer is about 29 inches thick. The upper part is dark gray, friable silt loam; the middle part is gray, friable silt loam with many distinct yellowish brown mottles; and the lower part is dark gray, friable silt loam. The underlying material is dark grayish brown, friable silt loam to a depth of about 32 inches, brown, very friable fine sandy loam to about 36 inches, and sandy loam to 60 inches. In some places the surface layer is fine sandy loam or silty clay loam, and in some small areas it is thinner.

Included with this soil in mapping are small areas of Cass, Grigston, Inavale, and Ord soils. The Cass, Grigston, and Inavale soils occur as slightly higher ridges and hummocks in the Leshara soils. Ord soils are in positions similar to those of this Leshara soil. Included soils make up 10 to 20 percent of the mapped areas.

This soil has moderate permeability and high available water capacity. Runoff is slow. The organic-matter content is moderate and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. The shrink-swell potential is low. The apparent seasonal high water table is between depths of 1.5 and 3 feet.

About half the acreage of this soil is cultivated, and the rest is in native grass. The fairly large acreages are cultivated. Smaller, odd shaped areas generally are in range or native hay meadow.

This soil has good potential for pasture and range and openland and rangeland wildlife habitat. Potential is fair for cultivated crops, windbreak plantings, and wetland habitat. It is fair to poor for recreational development and poor for most engineering uses.

The dryland crops most generally grown on this soil are corn and alfalfa. Spring-sown small grain generally is not grown because of excessive wetness early in spring. Alfalfa production varies, because in some years the moderately high water table restricts the root zone and in others it subirrigates the alfalfa. Tame grasses are planted in some areas and are used for pasture.

Occasional flooding and the moderately high water table are the major limitations on the soil. Diversions and erosion control in areas above this soil help to reduce potential flood damage. Shallow drains can remove impounded surface water. If suitable outlets are available, tile drains can help to lower the water table and control wetness. Managing crop residue so that it is kept on the surface helps to prevent soil blowing.

This soil is fairly well suited to irrigation. Corn and grass are the most suitable crops, but other commonly irrigated crops can also be grown. Sprinkler and gravity irrigation systems are suited. The conservation practices needed on this soil are the same in irrigated and dryfarmed areas.

The use of this soil as range, for either grazing or haying, is effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the native plant community. In addition, grazing the soil when wet results in surface compaction and hummocks, which make grazing or harvesting for hay difficult. Proper use, timely deferment of grazing or haying, and restricted use during wet periods help to maintain the plant community and the soil in good condition.

This soil is generally suited to field windbreaks, feedlot windbreaks, range or livestock windbreaks, and recreation or wildlife plantings. Only tree and shrub species that can tolerate a high water table are suited. Establishing seedlings can be a problem during wet periods. The abundant and persistent herbaceous vegetation that grows on these sites is a concern in establishing and managing trees.

This soil has severe limitations as a site for dwellings because of occasional flooding and wetness. Dwellings should not be located in this area unless they are protected from flooding. Flooding and wetness are severe limitations for sanitary disposal systems. The soil is not a suitable site for roads because of the severe limitations of flooding, wetness, and frost action. For access roads, use of artificial drainage and elevated roadbeds may be possible.

Capability unit IIw-4 dryland, IIw-6 irrigated; Subirrigated range site; windbreak suitability group 2.

LsC—Lynch silty clay, 2 to 6 percent slopes. This gently sloping, well drained soil is on uplands, colluvial fans, and a few stream terraces. The areas occur below the light shale beds on the long, smooth lower side slopes where accumulation of clay sediments is thickest. They range from 5 to 40 acres.

Typically the surface layer is dark grayish brown, friable silty clay. It is generally about 9 inches thick but ranges from 7 to 14 inches. The subsoil is firm silty clay about 25 inches thick. The upper part is light olive brown, and the lower part is light yellowish brown and pale yellow. The underlying material below a depth of 34 inches is pale yellow to olive yellow massive clay and shaly clay

that has many dispersed gypsum crystals. In some areas bedded shale occurs below 40 inches. In a few areas the surface layer is thicker than 20 inches.

Included with this soil in mapping are small areas of Hall soils, which are lower on the landscape than this Lynch soil. The included soils make up to 5 to 10 percent of each mapped area.

This soil has slow permeability. Runoff is medium. The available water capacity is low, and shrink-swell potential is high. The organic-matter content is low, and natural fertility is low. Reaction is moderately alkaline through the entire soil. Because of the high lime content, this soil is low in available phosphorus. Phosphate should be applied each year in only the amount needed by plants.

This soil has a friable surface layer and if well managed, has fair to good structure. It is difficult to keep in good tilth unless it is tilled at the proper moisture content. It puddles readily if worked or trampled when wet. Because of the fine texture, this soil releases moisture slowly to plants and is somewhat droughty.

Most of the acreage is in cultivated crops. Some small, isolated areas are still in native vegetation.

The soil has only fair potential for cultivated crops but good potential for hay and pasture. The potential is poor for trees and fair for openland and rangeland wildlife habitat and recreational facilities. It is poor for most engineering uses.

This soil is suited to dryland small grain, grain sorghum, corn, alfalfa, and hay and pasture grasses. Small grain is best suited because it matures early in summer. Grain sorghum is better suited than corn. Phosphorus is needed for good yields of alfalfa. It is commonly applied at the time of seeding and then as a topdressing every other year.

Because of the fine texture and gentle slope, this soil absorbs water slowly. The water that runs off, therefore, can cause erosion. Intertilled crops do not protect the soil from water erosion so well as small grain or hay crops. A conservation tillage system and the return of crop residue protect the soil from washing and soil blowing. A cropping system that returns a large amount of organic matter improves soil structure and increases water intake.

Long slopes should be terraced and farmed on the contour. Grassed waterways are needed in some drainageways to carry water from adjacent higher slopes and in this way reduce the risk of flooding and erosion.

This soil is not suited to irrigation because of the very low intake rate, excessive runoff, and highly erodible slopes. The transpiration and evaporation rates can exceed the intake rate.

This soil is suited to range, which is effective in controlling soil blowing and water erosion. Overgrazing or grazing when the soil is wet, however, results in surface compaction, excessive runoff, and poor tilth. Proper stocking rates, deferred grazing, a planned grazing system, and restricted use during wet periods help to keep the grasses in good condition.

This soil is poorly suited to field windbreaks and is only fairly well suited to farmstead windbreaks, livestock protection windbreaks, and plantings in wildlife and recreation areas. Because of the high clay content and the high lime content of the soil, only tree and shrub species that tolerate droughtiness and a high calcium content are suited.

Limitations are severe for building foundations and roads because the soil expands when wet and shrinks when dry. Proper drainage should be designed around building foundations, and roads should be graded to provide drainage. The slow percolation rate is a severe limitation for septic tank absorption fields. Increasing the size of the absorption area may help to overcome this problem. Some sewage lagoons are used for onsite waste disposal.

Capability unit IIIe-4; Limy Upland range site; windbreak suitability group 9.

LsD—Lynch silty clay, 6 to 11 percent slopes. This moderately deep, strongly sloping, well drained soil is on the broad ridgetops and lower side slopes of uplands. It formed in light shales, which are typically lower on the landscape than the adjoining dark shales. Individual areas are 5 to 70 acres.

Typically the surface layer is silty clay about 8 inches thick. The upper part is friable and dark grayish brown. The lower part is firm and grayish brown. The subsoil is firm silty clay about 20 inches thick. The upper part is light olive brown, and the lower part is light yellowish brown and light olive brown. The underlying material is light yellowish brown and pale yellow silty clay, clay, and shale fragments interspersed with many lime and gypsum crystals. In some areas bedded shale occurs below 40 inches. In a few small areas the surface layer is thicker than is typical.

Included with this soil in mapping are small areas of Bristow soils. These included soils make up less than 15 percent of the total acreage.

This soil has slow permeability and rapid runoff. After dry periods when cracks form, the initial intake is rapid. The available water capacity is low. The shrink-swell potential is high. The organic-matter content is low, and natural fertility is low. Reaction is moderately alkaline through the entire soil. This soil is low in available phosphorus because the high lime content makes the phosphorus unavailable to plants.

The soil has a friable surface layer but is difficult to keep in good tilth unless it is tilled at the proper moisture content. It puddles readily if worked or trampled when wet. Because of the fine texture and high content of calcium, the soil releases moisture slowly to plants and is somewhat droughty.

About 60 percent of the acreage is under cultivation. The rest is still in native grasses.

The soil has poor potential for cultivated crops and fair potential for range, hay, and pasture. The potential is poor for trees and recreational facilities. It is fair for openland and rangeland wildlife habitat. It is poor for most engineering uses.

This soil is poorly suited to cultivated crops. The crops most often grown are oats, barley, grain sorghum, and alfalfa. Phosphorus is needed for legumes. It is commonly applied at the time of seeding and then as a topdressing every other year.

If these soils are cultivated, a cropping system can be used that consists mainly of close-growing crops, such as small grain, legumes, and legume-grass mixtures. Legumes and grasses can be grown about half the time and close-sown crops the rest of the time. If row crops are included in the cropping sequence, terracing, contour farming, crop residue, and a conservation tillage system can be used to control erosion and conserve moisture. Grass cover helps to control erosion in natural drainageways.

This soil is suitable for range, which is effective in controlling erosion. Overgrazing, however, reduces the protective cover and deteriorates the natural plant community, resulting in severe soil losses through water erosion. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range condition (fig. 12).

This soil is poorly suited to field windbreaks. It is fairly well suited to farmstead and livestock windbreaks and to wildlife plantings. Because of the high clay content and the high lime content of the soil, only tree and shrub species that tolerate droughtiness and a high calcium content are suited. The water erosion hazard is a serious problem on these strongly sloping soils.

This soil is poorly suited as a site for dwellings and roads. The high shrink-swell potential causes soil movement with alternate wetting and drying, which in turn causes structural damage to footings and foundations. Adequate drainage is needed to prevent the soil from becoming saturated. Local roads can be graded to shed water and suitable base material brought in from outside of the area. This soil is poorly suited to septic tank absorption fields and sewage lagoons because of the slope, the slow permeability, and the moderate depth to bedrock. Deeper, less sloping sites should be selected on the foot slopes or on the broader ridgetops.

Capability unit IVe-4; Limy Upland range site; windbreak suitability group 9.

LyD—Lynch-Bristow silty clays, 6 to 11 percent slopes. This map unit consists of strongly sloping, well drained soils on upland ridges and side slopes. The soils formed in light shales. They are lower on the landscape than the adjoining Labu and Sansarc soils, which formed in dark shales. Individual areas range from 10 to 80 acres. They are 60 to 70 percent Lynch soil and 30 to 40 percent Bristow soil. The Lynch soil is on the plane or slightly convex side slopes, and the Bristow soil is on the more convex, sharper ridgetops and the steeper side slopes. Areas of the two soils were so intricately mixed or so small in size that it was not practical to map them separately at the scale selected.

Typically the Lynch soil has a surface layer of firm, grayish brown silty clay about 9 inches thick. The subsoil is very firm silty clay about 15 inches thick. The upper part is light olive brown. The lower part is light yellowish brown and contains fine lime accumulations. The underlying material is pale yellow shaly clay that has many dispersed gypsum and lime crystals. In some places the soil has a dark colored surface layer.

Typically the Bristow soil has a surface layer of firm, pale brown silty clay about 7 inches thick. The underlying material is firm shaly clay about 10 inches thick. The upper part is light yellowish brown, and the lower part is pale yellow. Accumulations of lime and gypsum crystals are visible in cracks and seams. Fractured pale yellow shale is at a depth of about 17 inches.

Included with these soils in mapping are small areas of Boyd and Sansarc soils and areas of shale outcrop. Those soils are higher on the landscape than the Lynch and Bristow soils. The shale outcrop is on ridges. The included areas make up 5 to 15 percent of the total acreage.

These soils have slow permeability. The available water capacity is low in the Lynch soil and very low in the Bristow soil. Both soils have poor tilth, are difficult to work, and release moisture slowly. Both shrink when dry and swell when wet. The organic-matter content and natural fertility are low. The amount of available phosphorus is low because of the high lime content. Reaction is moderately alkaline throughout.

Areas of this complex that are adjacent to less sloping soils are generally cultivated. Areas adjacent to steeper soils are in native range. About 60 percent of the acreage is range and the rest is under cultivation.

The soils have poor potential for cultivated crops and fair potential for range. They have poor potential for trees and for recreational facilities. Potential for wildlife habitat is fair on the Lynch soil and poor on the Bristow soil. Potential is poor for most engineering uses.

These soils are poorly suited to cultivated crops. They are generally better suited to small grain, grain sorghum, and hay and pasture crops than to corn. Phosphate fertilizer is needed for alfalfa. It is commonly applied at the time of seeding and then as a topdressing every other year.

Because these soils are fine textured and have strong slopes, considerable rainwater runs off. Erosion is a problem unless the surface is protected by vegetation or crop residue. A cropping system consisting mainly of such close-growing crops as small grain, legumes, and hay and pasture grasses can be used. Legumes and grasses can be grown about half the time and close-sown crops the rest of the time. If row crops are included in the cropping sequence, the water erosion hazard is increased. Terracing, contour farming, grassed waterways, and tillage that leaves crop residue on the surface can be used in controlling erosion and conserving moisture. Grass cover helps to reduce erosion in natural drainageways.

This soil is suited to range, which is effective in controlling erosion and conserving moisture. Overgrazing, however, reduces the protective cover, thus deteriorating the plant community and resulting in soil losses through

water erosion. Grazing when the soil is wet results in surface compaction. Proper stocking rates, deferred grazing, a planned grazing system, and restricted use during wet periods help to keep the grasses in good condition.

Generally the soils in this unit are poorly suited to windbreak plantings of any kind. The high clay and calcium content makes them droughty. In addition, the Bristow soil is too shallow and too steep for machine planting. Some areas can be used for recreation, wildlife, and forestation plantings if tolerant tree or shrub species are hand planted or other special approved practices are used.

If buildings are constructed on these soils, foundations and footings should be designed to prevent structural damage caused by shrinking and swelling. The underlying shale beds are soft and unstable and slippage is common. Artificial drainage around the buildings should be provided to keep the soils from becoming saturated. Local roads should be graded to shed water, and suitable base material should be hauled in from outside of the area. Sewage lagoons and septic tank filter fields should be located on the deeper, less sloping soils on foot slopes or on the broader ridgetops.

Capability unit IVe-4; Lynch soil in Limy Upland range site, windbreak suitability group 9; Bristow soil in Shallow Limy range site, windbreak suitability group 10.

LyF—Lynch-Bristow silty clays, 11 to 30 percent slopes. This map unit consists of moderately steep and steep, well drained soils on upland ridges and side slopes. Most areas are dissected by shallow drainageways. Soils in this unit occupy the highest slopes in the light colored shale beds. The adjacent dark colored shales are above these soils on the landscape. Areas of this unit range from 20 to 200 acres. Lynch soils make up 40 to 50 percent of the complex, and Bristow soils 35 to 50 percent. The Lynch soil is on the smoother, lower side slopes and the Bristow soil is on shorter, steeper side slopes of ridges or points and on the shoulders of drainageways. Areas of the two soils were so intricately mixed that it was not practical to map them separately at the scale selected.

Typically the Lynch soil has a surface layer of friable, dark grayish brown silty clay about 7 inches thick. The subsoil is about 15 inches thick. The upper part is firm, light olive brown silty clay, and the lower part is very firm, light yellowish brown silty clay. The substratum is about 5 inches thick. It is yellow to yellowish brown silty clay and has many interspersed lime and gypsum crystals. Pale yellow shaly clay is at a depth of 27 inches. In some areas the soil has a thick, darker colored surface layer.

Typically the Bristow soil has a surface layer of friable, pale brown silty clay about 8 inches thick. The underlying material is about 11 inches thick. It is firm, light yellowish brown, light gray, and pale yellow shaly clay. There are visible accumulations of gypsum and lime at a depth of 19 inches.

Included with these areas in mapping are small areas of Boyd and Sansarc soils and small areas of shale outcrop. Those soils are on higher slopes than the Lynch and Bristow soils. The shale outcrop is on the ridges. The included areas make up to 15 percent of the total acreage.

These soils have slow permeability. The available water capacity is low in the Lynch soil and very low in the Bristow soil. Runoff is rapid on the Lynch soil and very rapid on the Bristow soil. The shrink-swell potential is high. Both soils have poor tilth and are difficult to work. They release moisture slowly to plants. The organic-matter content and natural fertility are low. The surface layer is moderately alkaline.

Almost all the acreage of this unit is native range. The soils have very poor potential for crops. They are too steep and too erodible for cultivation. They have fair to poor potential for range and rangeland wildlife habitat. Potential is poor for trees and for recreational facilities. It is poor for most engineering uses.

These soils are best suited to range. Erosion is a problem unless the surface is protected by vegetation. Grazing should be carefully controlled so that a protective cover of grasses is maintained. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range condition.

Windbreak plantings of any kind are generally not suited to this unit because of the steep slopes and the unfavorable soil characteristics.

Dwellings, sanitary facilities, and local roads are not suited to this unit because of the steep slopes and the unstable nature of the shales. Such structures should be located on some of the deeper, less sloping soils on foot slopes or on broader ridgetops. Livestock ponds, if constructed, should not exceed design limits determined by slope, depth to shale, and the high content of carbonates and sulphates.

Capability unit VIs-4; Lynch soil in Limy Upland range site, Bristow soil in Shallow Limy range site; windbreak suitability group 10.

MaG—Mariaville-Paka loams, 15 to 40 percent slopes. This map unit consists of steep and very steep, well drained soils on upper side slopes bordering deeply entrenched streams and larger drainages. Most areas are dissected by shallow drainageways. Some areas are irregular in shape. Some are long and narrow. They range from 10 to 250 acres. This complex is 45 percent Mariaville soils, 40 percent Paka soils, and about 15 percent other soils. Mariaville soils are generally on the short, steep lower side slopes that break into the drainageways, and Paka soils are generally on smoother, less sloping rounded ridgetops and points above the Mariaville soils. Areas of the two soils were so intricately mixed and so small that it was not practical to map them separately at the scale selected.

Typically the Mariaville soil has a surface layer of dark grayish brown, friable loam about 5 inches thick. A transitional layer is light olive brown, friable silty clay loam about 7 inches thick. The underlying material is about 5 inches thick. It is light yellowish brown, firm silty clay loam. Light yellowish brown siltstone is at a depth of about 17 inches.

Typically the Paka soil has a surface layer of dark grayish brown, friable loam about 8 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable clay loam, and the lower part is light grayish brown, friable silty clay loam. The underlying material is light gray silt loam to a depth of 44 inches and light gray siltstone to 60 inches. In places the surface layer is silt loam.

Included with these soils in mapping and making up 5 to 20 percent of the unit are small areas of Anselmo, Dunday, Labu, Meadin, Reliance, Sansarc, and Simeon soils. Anselmo, Dunday, Meadin, Reliance, and Simeon soils generally occur above the Mariaville and Paka soils on the landscape. Labu and Sansarc soils are generally below Mariaville and Paka soils.

Permeability of these soils is moderate above the siltstone. The available water capacity is low in the Mariaville soil and high in the Paka soil. Surface runoff is rapid on both. The shrink-swell potential is low in the Mariaville soil and moderate in the Paka soil. The organic-matter content is low in the Mariaville soil and the fertility level is low. The organic-matter content is moderate in the Paka soil and the fertility level is medium. Both soils have good tilth. They absorb moisture easily and release it readily to plants. The root zone extends to the upper part of the underlying siltstone.

Almost all the acreage is still in native grass and is used for grazing. The soils have fair to good potential for range and rangeland wildlife habitat. They have very poor potential for farming and tree and shrub plantings and poor potential for recreational and engineering uses.

This unit is best suited to range. The soils are subject to water erosion if the vegetation is destroyed or allowed to deteriorate into poor condition. The Mariaville soil is droughty because of low available water capacity and rapid runoff. Management that maintains an adequate plant cover reduces runoff and thus helps to prevent soil losses and improves the moisture supplying capacity. Overgrazing reduces the protective cover and deteriorates the potential native plant community. Proper use, timely deferment, and a planned grazing system help to maintain or improve the range and keep it in good condition. Potential pond reservoir sites are plentiful on these soils.

These soils are not suited to cultivated crops because they have excessively steep slopes. In addition, the Mariaville soil is shallow over bedrock. Windbreak plantings are not generally suited because of unfavorable soil qualities and characteristics. Some areas can be used for recreation, wildlife, and forestation plantings if tolerant tree or shrub species are hand planted or other special approved practices are used.

Restrictions for dwellings on these soils are severe, mainly because of steep slopes. Alternate sites should be found where the slopes are not as steep and the soil is deeper. These soils are too steep and the underlying bedrock too shallow for proper functioning of septic tank absorption fields and sewage lagoons. Suitable sites can generally be found on some of the deeper, less sloping soils on foot slopes or on the broader ridgetops. Limitations for local roads are severe because of steep slopes. The roads should be designed to complement slope.

Capability unit VIs-4; windbreak suitability group 10; **Mariaville soil is in Shallow Limy range site, Paka soil is in** Silty range site.

MeE—Meadin sandy loam, 3 to 17 percent slopes. This soil is shallow over gravel. It is on rounded ridgetops and side slopes bordering gravelly upland tablelands. Individual areas are irregular in shape and range from 10 to 100 acres.

Typically the surface layer is friable, dark grayish brown sandy loam about 8 inches thick. The transitional layer is friable, dark yellowish brown gravelly sandy loam about 5 inches thick. The underlying material is yellowish brown, very gravelly coarse sand in the upper part and very pale brown gravelly coarse sand in the lower part to a depth of 60 inches.

Included with this soil in mapping are small areas of Jansen and O'Neill soils. The Jansen soils are commonly above the Meadin soil on the landscape and the O'Neill soils are below. Also included are small areas of Mariaville and Paka soils, which are lower than the Meadin soil on the landscape. The included areas make up to 20 percent of the total mapped acreage.

Permeability is rapid in the surface layer and transition layer and very rapid in the underlying material of gravelly coarse sand. The available water capacity, organic-matter content, and natural fertility are low. Runoff is moderate to rapid, depending on the slope gradient. The shallowness over coarse sand and gravel makes this soil droughty and limits root penetration and moisture storage.

This soil is used for grazing. Most of the acreage is native rangeland. The soil has very poor potential for cultivated crops, tame hay or pasture, and tree plantings. It has poor potential for range. It has fair potential for recreational facilities and rangeland wildlife habitat. It has poor potential for openland habitat and for most engineering uses.

This soil is generally not cultivated because of droughtiness and the water erosion hazard caused by the excessive slope gradients. It can be used as native grass range, which is effective in controlling water erosion and soil blowing. Overgrazing, however, reduces the protective cover and deteriorates the potential native plant community. Proper use, timely deferment, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is generally not used for windbreak plantings of any kind because of an unfavorable moisture relationship. A limited root zone and low available water capacity are the main hazards. Water erosion is also a hazard on the steeper slopes. Some areas can be used for recreation, wildlife, and forestation plantings if drought tolerant tree or shrub species are hand planted or other special approved practices are used.

The use of the soil as a site for dwellings, septic tank filter fields, and local roads and streets is limited because of slope. Grading to modify slope is needed, or an alternate site should be selected. Sewage lagoons should not be built on this soil unless they are sealed or lined to prevent seepage. In some areas absorption fields can contaminate nearby underground water supplies.

Capability unit VIs-4; Shallow to Gravel range site; windbreak suitability group 10.

NoC—Nora silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and side slopes in the drainage divides that are adjacent to or within a few miles of the Missouri River Valley. Slopes are short and convex. Areas range from 10 to 30 acres.

Typically the surface layer is very friable, dark grayish brown silt loam about 6 inches thick. It ranges from 4 to 7 inches in thickness in most areas. The subsoil is friable silt loam about 24 inches thick. The upper part is dark grayish brown and has few dispersed lime accumulations. The lower part is calcareous and has common soft lime accumulations. The underlying material to a depth of 60 inches is brown, calcareous silt loam. In some areas the surface layer is less than 7 inches thick, and free lime is nearer the surface than is typical.

Included with this soil in mapping are small areas of nearly level or very gently sloping Eltree soils. They make up 10 to 15 percent of each mapped area.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. Runoff is medium. This soil is easy to work and releases moisture readily to plants. The shrink-swell potential is moderate.

Nearly all the acreage is cultivated. The soil has good potential for the commonly grown dryland cultivated crops, for pasture, and for trees. It has fair potential for rangeland. It has good potential for openland and rangeland wildlife habitat and recreational facilities and fair to good potential for most engineering uses.

This soil is suited to dryland corn, small grain, grain sorghum, and alfalfa and grasses for hay and pasture. In areas used for intertilled crops, water erosion and soil blowing are hazards. Conservation measures, such as terraces, contour farming, and grassed waterways, along with a conservation tillage system, which leaves crop residue on the surface, are needed to control erosion. Crops on this soil generally respond to nitrogen fertilizer.

This soil is suited to border, furrow, and sprinkler irrigation. The main problem in border and furrow irrigation is slope. Bench leveling alters the surface of the land so that the soil has a low grade and irrigation water flows slowly. The main problems in sprinkler irrigation are the moderate intake rate, runoff and water loss, and soil blowing and water erosion. Application of irrigation water should be adjusted to the natural intake rate of the soil to avoid increasing water erosion. The conservation and cultural practices needed to control erosion are the same in irrigated and dryfarmed areas.

The use of this soil for range is highly effective in controlling erosion. Overgrazing the range reduces the protective cover and deteriorates the plant community. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil is well suited to field windbreaks, farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. All tree and shrub species that are moderately drought resistant are suited. Water erosion and moisture competition from grass and weeds are the principal hazards to tree survival.

This soil has moderate limitations as a site for dwellings because of moderate shrink-swell. To reduce or eliminate damage from shrinking and swelling, the abutting soil material should be removed and replaced or completely modified to a sand, loamy sand, or coarse sandy loam texture. Limitations are moderate for septic tank filter fields because of permeability. The filter field should be designed taking this limitation into consideration. Sewage lagoons are suited to this soil, but the slope should be modified and the bottom of the lagoon sealed or lined to prevent seepage. Local roads should be designed to reduce frost action, which can require modification of the soil material.

Capability unit IIe-1 dryland, IIIe-6 irrigated; Silty range site; windbreak suitability group 4.

NoD—Nora silt loam, 6 to 11 percent slopes. This deep, well drained, strongly sloping soil is in the loess uplands. It is on drainage divides and ridgetops adjacent to or within a few miles of the Missouri River Valley. Areas are irregularly shaped and range from 10 to 25 acres.

Typically the surface layer is very friable, dark grayish brown, neutral silt loam about 6 inches thick. The subsoil is about 19 inches thick. The upper part is very friable, dark grayish brown, mildly alkaline silt loam, and the lower part is friable, brown, moderately alkaline silt loam. Soft fine prominent lime accumulations are common. The underlying material to a depth of 60 inches is brown and light yellowish brown, calcareous silt loam.

Included with this soil in mapping are small areas of a soil that has a thin surface layer and is calcareous to the surface. These included areas make up less than 15 percent of the acreage.

This soil has moderate permeability and a high available water capacity. The organic-matter content is moderate or low, and natural fertility is medium. The soil is low in nitrogen and phosphorus. Soil reaction is neutral in the surface layer, mildly alkaline in the upper part of the subsoil, and moderately alkaline in the lower subsoil and in the underlying material. This soil is easy to work and releases moisture readily to plants.

Most of the acreage is cultivated. The soil has fair potential for the common cultivated crops, grasses, and legumes. It has good potential for windbreaks. It has good potential for openland and rangeland wildlife habitat and fair potential for rangeland and most engineering uses and for recreational facilities.

This soil is well suited to dryland corn, oats, grain sorghum, and alfalfa hay. Water erosion is the principal hazard. Reducing runoff, conserving moisture, and increasing the supply of organic matter are the main concerns of management. The risk of erosion can be controlled by terraces, contour farming, grassed waterways, and conservation tillage, which leaves most of the crop residue on the soil surface as a protective mulch.

Only sprinklers are suitable for irrigating this soil. Water erosion, soil blowing, excessive runoff, and water loss are the principal hazards. Water should be applied at a low rate so that it infiltrates the soil and does not become a source of runoff and erosion. Under irrigation, this soil is best suited to close-sown crops such as small grain, alfalfa, and grass. It is less suited to row crops. The conservation and cultural practices needed to control erosion are the same in irrigated and dryfarmed areas.

This soil is also well suited to pasture and range. Native warm season grasses or a mixture of introduced cool season grasses and legumes can be seeded, but the two types of range should be managed separately. The use of grass is highly effective in controlling erosion. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil is suited to farmstead and livestock windbreaks. Survival of suitable species is good, and growth is fair. Erosion, drought, and competition for moisture from weeds and grass are the principal hazards. Proper site preparation and timely cultivation between the tree rows are needed.

This soil has fair suitability as a site for dwellings. Limitations are slope, shrinking and swelling, and low strength. The site can be graded to modify the slope or the dwelling can be designed to accommodate the slope. Shrinking and swelling of the soil can be reduced by strengthening the foundation or by removing the abutting material and replacing it with coarse material. The steepness of slope is a problem in installing septic tank absorption fields and sewage lagoons. The lateral field should be constructed on the contour. Sewage lagoons should be located on the lower slopes. Local roads and streets can be built on the contour to compensate for slope. Modification or replacement of soil material may be needed to overcome low strength and to reduce frost action.

Capability unit IIIe-1 dryland, IVe-6 irrigated; Silty range site; windbreak suitability group 4.

Oa—Onawa silty clay, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands of the Missouri River Valley. It occurs in slightly depressed channeled areas of the flood plain. Occasionally water runs in from adjoining land and ponds on the surface. The rare flooding by overflow from the Missouri River has been largely eliminated since construction of the large dams. Individual areas range from 10 to 80 acres.

Typically the surface layer is firm, grayish brown silty clay about 7 inches thick. The underlying material to a depth of 28 inches is firm, grayish brown silty clay that has thin strata of silty material and few to common, distinct yellowish brown and strong brown mottles. To 60 inches it is stratified light brownish gray and light yellowish brown, friable silt loam and very fine sandy loam that has thin layers of more clayey material. In some places the clayey material extends to a depth of more than 30 inches. In some areas the surface layer is darker colored than is typical.

Included with this soil in mapping are small areas of Albaton, Blake, and Haynie soils. Albaton soils are at the lower levels on the landscape. Blake and Haynie soils are at higher levels. These included soils make up less than 15 percent of the total acreage.

Permeability of this soil is slow in the upper part and moderately rapid in the lower part. The shrink-swell potential is high in the upper 28 inches and moderate below. Runoff is slow. The organic-matter content is moderately low, and natural fertility is medium. The available water capacity is high. This soil absorbs moisture very slowly. It is difficult to work and to keep in good tilth. It is sticky when wet and hard when dry, so it should be tilled at the proper moisture content. The seasonal high water table ranges from a depth of 2 to 4 feet in spring.

Most of the acreage is cultivated. Some small areas that have not been cleared for farming have a sparse cover of trees and an understory of grass. These uncleared areas are used for grazing and wildlife habitat.

This soil has good potential for dryland and irrigated crops. It has fair potential for windbreak plantings and openland and rangeland wildlife habitat. It has good potential for rangeland and wetland habitat and for tame pasture and hay. It has poor potential for most recreational and engineering uses.

This soil is suited to the dryland crops commonly grown in the county. Wetness, poor tilth caused by the clayey texture, slow permeability, and slow runoff are limitations to crop growth. The soil dries slowly in spring and stays wet during periods of heavy rainfall. If tilled when wet, it becomes cloddy and very hard. In dry periods the soil cracks considerably as it dries, and damage to plant roots can be extensive. Wide cracks in the soil also allow excessive evaporation of soil moisture. Maintaining a loose, finely granular condition at the surface by shallow cultivation when the soil is dry helps to reduce the loss of moisture through soil cracks. Seedbed preparation and planting are commonly delayed in the spring when the soil is wet, and plant germination is irregular. Late-planted crops are generally best suited. Grain sorghum and soybeans can be planted later than corn. The soil can be worked in the summer and planted to wheat in fall, when it is likely to be dry. Forage sorghum for livestock feeds can be grown, and tame grasses and legumes are also well suited.

Where surface drainage is inadequate, the excess water can be drained away by shallow V-drains. Because permeability is so slow, tile drains do not effectively control wetness. Fall plowing when moisture conditions are

likely to be favorable allows the soil to mellow into better tilth over winter. Soil blowing can be controlled by leaving strips of crop residue standing in unplowed areas in the fields. A cropping system that includes grasses and legumes and that returns a large amount or organic matter to the soil improves soil structure and increases water intake.

Under irrigation, this soil is suited to most crops. Corn is the principal crop. Alfalfa tends to increase the movement of water through the soil because the roots open up the clay layer. Land leveling is needed for gravity irrigation. Sprinklers are suited to this soil, but the crops die in low areas unless surface drainage is improved. The low intake rate of the soil requires a lower water application rate than is possible using a center-pivot system. Sprinklers that operate in sets at one location can be adjusted to provide the proper application rate. The conservation and cultural practices needed to control erosion and to maintain organic matter, good tilth, and fertility are the same in irrigated and dryfarmed areas.

The use of this soil for range is highly effective in controlling wind and water erosion. Overgrazing and silt deposition, however, reduce the protective cover and deteriorate the potential plant community. Grazing when the soil is wet results in compaction of the soil. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for planting trees. Field windbreaks, farmstead and feedlot windbreaks, range and livestock windbreaks and plantings in recreation and wildlife areas are all suited. Survival and growth are good if selected trees can tolerate occasional wetness. Establishing seedlings can be a concern in wet years. This soil shrinks and cracks when dry, and as a result air can enter and dry out roots of newly established plants. The abundant and persistant herbaceous vegetation that grows on this site is a concern of management in establishing trees.

Because of the hazard of occasional flooding and the severe limitations of wetness, low strength, and high shrink-swell potential, this soil is poorly suited to dwellings. Dwellings should probably be located elsewhere unless they are protected from flooding. Buildings can be constructed on suitable fill material or on pilings as protection from the flooding and the wetness from the water table. Artificial drainage and footing drains help to keep the soil dry. The soil material abutting foundations should be replaced with readily available material of little or no clay content and having low shrink-swell properties. Shallow excavations should be dug during dry periods. If the soil is not wet, operation is easier and cave-in problems can be avoided.

The slow permeability, wetness, and susceptibility to flooding severely limit the use of this soil for septic tank absorption fields. Alternate sites should be selected. The coarse underlying material of this soil causes seepage and is a limitation for sewage lagoons. If constructed, lagoons should be sealed and protected from flooding.

Local roads and streets have severe limitations because of the wetness, low strength, and high shrink-swell potential of this soil. Artificial drainage and elevated roadbeds may be a solution to these problems. Roadbed material should be modified to overcome shrinking and swelling. Routing roads to bypass wet areas may be possible.

Capability unit IIw-1 dryland, IIw-1 irrigated; Clayey Overflow range site; windbreak suitability group 2.

Oe—O'Neill fine sandy loam, 0 to 2 percent slopes. This well drained, nearly level soil is on the uplands. It is moderately deep over sand and gravel. Individual areas are irregular in shape and range from 10 to more than 300 acres.

Typically the surface layer is dark grayish brown, friable fine sandy loam. It is generally about 8 inches thick but ranges from 7 to 10 inches in most areas. The subsoil is about 14 inches thick. The upper part is dark brown, friable sandy loam, and the lower part is brown, friable fine sandy loam. The underlying material is pale brown gravelly coarse sand to a depth of about 36 inches and very pale brown coarse sand below. In a few areas, the surface layer is a loamy fine sand or loam.

Included with this soil in mapping are small areas of Jansen soils in slightly depressed areas. Also included are small areas of Simeon and Dunday soils, which are higher on the landscape than this O'Neill soil. The included areas make up less than 15 percent of the unit.

Permeability of this soil is moderately rapid through the subsoil and rapid through the underlying material. Runoff is slow. The available water capacity is low, and the organic-matter content is moderately low. Natural fertility is medium. Root penetration is largely restricted by the underlying gravelly coarse sand.

About two-thirds of the acreage is native grassland. The rest is cultivated, mostly under irrigation.

The soil has only fair potential for dryland crops because of low available water capacity. It has fair to good potential for irrigated crops. It has fair potential for pasture and range, good potential for openland and rangeland wildlife habitat, and fair potential for recreational facilities. It has fair to good potential for trees and for most engineering uses. It has fair potential for windbreaks.

This soil can be used for dryland corn, sorghum, small grain, and alfalfa. Low available water capacity is a major limitation. Small grain and the first cutting of alfalfa are generally more desirable because they mature early when rainfall is more plentiful. In cultivated areas, soil blowing is a hazard. A cropping system that includes conservation tillage and keeps the soil covered most of the year reduces the hazard of soil blowing and conserves moisture.

Under irrigation, this soil can be used for corn, sorghum, small grain, alfalfa, and tame grasses. Because of the low water holding capacity, applications of irrigation water should be light and frequent. Automatic sprinkler systems are the best method of irrigation. Gravity irrigation is suitable, but because of the high intake rate,

the length of field irrigation runs must be limited. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

The use of the soil for pasture and range or hay is highly effective in controlling soil blowing and water erosion. Overgrazing should be avoided. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil can be used for farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. Only tree and shrub species that are very drought tolerant are suited. Moisture competition from grass and weeds and droughty conditions are the principal hazards in establishing seedlings. Susceptibility to soil blowing is also a hazard. Maintaining strips of sod or other vegetation between the tree rows and restricting cultivation to the tree row are means of controlling the hazard of erosion. Selective chemical treatment is effective in weed control.

This soil can be used as a site for dwellings and septic tank absorption fields. The rapid permeability in the underlying material can allow seepage from the absorption field to contaminate nearby underground water supplies. Seepage is a problem for sewage lagoons unless the bottom is sealed by special treatment. This soil has moderate limitations for local roads and streets because of moderate frost action and low strength. The road base should be strengthened and designed to reduce frost action potential.

Capability unit IIIe-3 dryland, IIIe-9 irrigated; Sandy range site; windbreak suitability group 5.

OeC—O'Neill fine sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is moderately deep over sand and gravel. It is on the lower side slopes that break away from the gravelly tablelands of uplands. Individual areas are on plane to slightly convex side slopes, are irregular in shape, and are 5 to 25 acres.

Typically the surface layer is a fine sandy loam about 9 inches thick. The plow layer is dark grayish brown, and the next layer is very dark grayish brown. The subsoil is dark brown, friable fine sandy loam in the upper part and yellowish brown sandy loam in the lower part. In some profiles there is a thin clayey layer above the underlying material. Yellowish brown gravelly sandy loam is at about 26 inches. Below 34 inches is gravelly sand and gravelly coarse sand. In some places the surface layer is thicker than is typical.

Included with this soil in mapping are small areas of Jansen, Meadin, and Onita soils. Jansen soils are in positions similar to those of this O'Neill soil on the landscape. Meadin soils are on higher slopes. Onita soils have more gentle slopes and are lower on the landscape. The included areas make up less than 15 percent of the total mapped acreage.

Permeability of this soil is moderately rapid through the subsoil and rapid through the underlying material. The available water capacity is low. The organic-matter content is moderately low, and natural fertility is medium. This soil is easy to work and absorbs moisture readily. Surface runoff is medium. Root penetration is largely restricted by the underlying sand and gravel.

Almost half the acreage is in native grass and is used for grazing. The rest is cultivated.

This soil has poor potential for dryland crops and fair potential for irrigated crops. It has fair potential for range and pasture, good potential for openland and rangeland wildlife habitat, and fair potential for recreational facilities. It has fair potential for trees and for most engineering uses.

Dryland corn, grain sorghum, small grain, and alfalfa can be grown. Soil blowing and water erosion are the main hazards. Low available water makes this soil droughty. The risk of soil blowing can be controlled by using conservation tillage, which leaves crop residue on the surface. Contour farming, terracing, and grassed waterways conserve moisture and help to control water erosion.

The main irrigated crops are corn, grain sorghum, alfalfa, and tame grasses. Frequent and light application of irrigation water are needed to avoid leaching the plant nutrients. Sprinklers are best for irrigating this soil. Under sprinkler irrigation, an extensive cropping system that includes mechanical, vegetative, and management practices is needed to control erosion. Gravity irrigation systems are not desirable. Because of slope and the high water intake rate, the length of runs must be limited.

The use of this soil for range is effective in controlling wind and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in severe losses through wind erosion. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil can be used for farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. Drought and moisture competition from grass and weeds are hazards in establishing seedlings. Soil blowing and water erosion are also hazards. Erosion can be controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation should be restricted to the tree rows. The use of selective chemical treatment is an effective means of weed control.

This soil can be used as a site for dwellings and septic tank filter fields. In some areas seepage from absorption fields can contaminate nearby underground water supplies. Seepage is a problem for sewage lagoons unless the bottom is sealed by special treatment. Local roads and streets have limitations because of frost action and low strength. The road base should be strengthened and graded to reduce frost action potential.

Capability unit IVe-3 dryland, IVe-9 irrigated; Sandy range site; windbreak suitability group 5.

OfD—O'Neill-Meadin fine sandy loams, 3 to 9 percent slopes. This map unit consists of well drained to excessively drained soils on undulating to rolling uplands. Areas occur on the higher side slopes that break away from gravelly tablelands. They are 20 to 150 acres. The O'Neill soil makes up 35 to 45 percent of this complex, and the Meadin soil, 30 to 40 percent. The O'Neill soil is on plane or convex mid and lower side slopes and on the broader ridgetops. The Meadin soil is on the upper side slopes and sharp slope breaks of the drainageways and on the narrow convex ridgetops. Areas of the two soils are so intricately mixed or so small in size that it is not practical to map them separately at the scale selected.

Typically the O'Neill soil has a surface layer of dark grayish brown, friable fine sandy loam about 9 inches thick. The subsoil is about 17 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is brown, friable sandy loam. The underlying material is a yellowish brown gravelly sand to a depth of 42 inches and a light yellowish brown gravelly sandy loam to 60 inches.

Typically the Meadin soil has a surface layer of dark grayish brown, friable sandy loam and gravelly sandy loam about 8 inches thick. Below this is a transition layer of dark grayish brown to brown, very friable gravelly sandy loam about 9 inches thick. Very gravelly coarse sand is below 18 inches.

Included with this unit in mapping are small areas of Anselmo, Paka, and Reliance soils. Anselmo and Paka soils are below the Meadin and O'Neill soils on the landscape. Reliance soils are on plane and convex lower foot slopes. The included soils make up less than 25 percent of the total acreage.

Permeability of the O'Neill soil is moderately rapid through the subsoil and rapid through the underlying material. Permeability of the Meadin soil is rapid through the upper part and very rapid through the underlying material. The available water capacity is low in both soils. The organic-matter content is moderately low in the O'Neill soil and low in the Meadin soil. Surface runoff is moderate to rapid. Natural fertility in the O'Neill soil is medium and in the Meadin soil is low. In both soils, the root zone extends only to the coarse gravelly material.

Nearly all the acreage of this unit is native grassland and is used for grazing. Where these soils are associated with deeper soils and soils on lesser slopes, a few areas are cultivated.

This map unit has fair to poor potential for range and good to fair potential for openland and rangeland wildlife habitat. It has fair potential for tame pasture and for recreational facilities. It has very poor potential for crops, fair to very poor potential for tree plantings, and poor potential for most engineering uses.

This unit can be used for range. The soils are subject to water erosion and soil blowing if the vegetation is destroyed or allowed to deteriorate into poor condition. Gullies form easily. Management that maintains an adequate plant cover helps to prevent excessive soil losses. Overgrazing reduces the protective vegetative cover and deteriorates the potential native plant community. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range condition.

This unit is generally not used for dryland cultivated crops because the soils are too coarse textured and droughty. It is poorly suited to irrigated crops. Where the soils are cropped, cultivation should be restricted to the lower slopes and the deeper soils. A conservation cropping system using conservation tillage, contour farming, and crop residue helps to control erosion.

The unit can be used for farmstead and livestock windbreaks. Plantings should be on the lower slopes and on the deeper soils. Plantings in recreation areas and to provide wildlife habitat are best suited. Only tree and shrub species that are highly drought tolerant are desirable. Moisture competition from grasses and weeds and drought conditions are the principal hazards in establishing seedlings. Soil blowing and water erosion are also hazards. Cultivation should be restricted to the tree rows.

This unit has slight limitations as a site for dwellings and septic tank filter fields. Contamination of nearby underground water supplies by seepage from absorption fields is a problem in some areas. Seepage is a problem for sewage lagoons unless the bottom is sealed by special treatment. Local roads and streets have limitations because of frost action and low strength. The road base should be strengthened and graded to reduce frost action potential.

Capability unit VIe-3 dryland, IVe-9 irrigated; O'Neill soil in Sandy range site, windbreak suitability group 5; Meadin soil in Shallow to Gravel range site, windbreak suitability group 10.

On—Onita silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained and moderately well drained soil is on loess uplands. It occupies slightly concave swales and broad ridges and divides between drainageways. Individual areas range from 10 to more than 600 acres.

Typically the surface layer is a friable silt loam about 18 inches thick. It is very dark grayish brown in the upper 7 inches and dark grayish brown in the lower 11 inches. The subsoil is about 20 inches thick. The upper part is dark grayish brown, friable silty clay loam, and the lower part is grayish brown, firm silty clay loam grading to light olive brown, firm heavy silt loam. The underlying material to a depth of 49 inches is olive, calcareous heavy silt loam. Below this to 60 inches it is pale olive, calcareous loam. In some places this soil has underlying material of shale, siltstone, sand, or gravel at a depth of 50 to 60 inches. In some areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Anselmo, Paka, Ree, and Reliance soils. All of these soils are on gently sloping, slightly convex side slopes. They make up 5 to 20 percent of each mapped area.

This soil has moderately slow permeability. Runoff is slow. The available water capacity is high. The shrink-

swell potential is moderate in the surface layer and high in the subsoil. The organic-matter content is moderate, and the natural fertility level is medium. This soil is easily penetrated by roots. It is easy to till and is suitable for intensive farming.

Almost all the acreage of this soil is cultivated. A few small isolated areas are still in native grass.

The soil has good potential for the commonly grown cultivated crops and for pasture and windbreaks. It has fair potential for range. It has good potential for openland and rangeland wildlife habitat and fair potential for recreational facilities. It has poor to fair potential for engineering uses.

This soil is well suited to all of the dryland crops commonly grown in the county. It is especially well suited to corn, grain sorghum (fig. 13), oats, and other field crops. Lack of sufficient rainfall is the principal limitation for crop production. Row crops can be grown year after year if proper amounts of fertilizer are used and if weeds, plant diseases, and insects are controlled. Crops respond well to additions of nitrogen fertilizer. Maintaining the supply of organic matter and a high fertility level are the principal concerns in management. Diversion terraces and grassed waterways help to prevent damage by runoff from adjacent higher areas.

Under irrigation, this soil has few restrictions. It is suited to all of the commonly irrigated crops, for example, corn, grain sorghum, alfalfa, and tame grasses. Proper distribution of irrigation water and maintenance of high soil fertility are the principal management concerns. Land leveling is needed in most areas to permit more uniform distribution of irrigation water, and it commonly is needed for border and furrow irrigation. Flooding from adjacent areas can be controlled by diversions. Sprinkler irrigation is also suited to this soil if application rates are adjusted to the natural intake rate of the soil to prevent ponding in low areas.

This soil is suited to range. Overgrazing the range reduces protective cover and deteriorates the plant community. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is well suited to field windbreaks, farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. The high clay content of the subsoil makes the soil somewhat droughty for newly planted seedlings, and growth may be only fair. Adapted kinds of trees have a good chance of survival and fair growth if the site is properly prepared and moisture competition from grass and weeds is controlled.

This soil is poorly suited to dwellings, mainly because of the high shrink-swell potential. Foundations and basement walls should be designed to withstand the shrinking and swelling of the soil. Abutting soil material can be replaced with readily available material of low clay content and low shrink-swell properties. Houses should be protected from flooding. Limitations are severe for septic tank absorption fields because of slow percolation. Larger than normal absorption fields may be needed. The soil is well suited to sewage lagoons. It is poorly suited to local roads. Low bearing strength and high shrink-swell potential are the main limitations. Replacement or modification of the soil material may be necessary.

Capability unit IIc-1 dryland, I-4 irrigated; Silty range site; windbreak suitability group 4.

Or—Ord fine sandy loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is in irregularly shaped tracts on bottom lands and in some upland depressions. It is occasionally flooded. Individual areas range from 5 to 60 acres.

Typically the surface layer is very friable fine sandy loam about 12 inches thick. The upper part is dark gray, and the lower part is dark grayish brown. The subsoil is friable fine sandy loam about 19 inches thick. The upper part is grayish brown, and the lower part is a very dark grayish brown. The underlying material is grayish brown, very friable sandy loam to a depth of about 34 inches. To 60 inches, it is light brownish gray sand. In some places the surface layer is loam and loamy fine sand.

Included with this soil in mapping are small areas of Barney, Cass, Grigston, Inavale, and Leshara soils. Barney soils are at slightly lower elevations than this Ord soil, nearer the stream channels. Cass, Grigston, and Inavale soils are at higher elevations. Leshara soils are in positions similar to those of this Ord soil. Included soils make up less than 15 percent of the total acreage.

This soil has moderately rapid permeability. The available water capacity is moderate. Surface runoff is slow. The shrink-swell potential is low. The organic-matter content is moderately low, and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. It is easily worked. The apparent seasonal high water table fluctuates between depths of 1 1/2 and 3 1/2 feet.

About two-thirds of the acreage is in native grass. The rest is cultivated. The cultivated acreage is in the larger soil areas.

This soil has good potential for pasture and range and for openland and rangeland wildlife habitat. It has fair potential for dryland cultivated crops, windbreak plantings, and wetland wildlife habitat. It has good potential for irrigated crops. It has fair to poor potential for recreational development and poor potential for most engineering uses.

Corn and alfalfa are the main dryland crops. Other commonly grown crops are also suited. Spring-sown small grain generally is not grown on this soil because of excessive wetness early in spring. Production of alfalfa varies. In some years the water table restricts the root zone, but in others it improves production by subirrigating the alfalfa. Areas of this soil are productive if they are planted to tame grasses and used for hay or pasture.

Wetness caused by a seasonal high water table and occasional flooding are the main limitations to use of this soil. The hazard of soil blowing is slight. Diversions and

erosion control in areas above this soil help to reduce potential flood damage. Shallow drains can remove impounded surface water. Where suitable outlets are available, tile drains can help to lower the water table and control wetness. Keeping crop residue on the surface helps in controlling soil blowing.

Under irrigation, this soil is best suited to corn, grass, and hay, but other commonly irrigated crops can also be used. Both sprinkler and gravity irrigation are suited. For gravity irrigation, short runs and light, frequent water applications are needed because of the coarse textured underlying material. The conservation practices needed are the same in irrigated and dryfarmed areas.

Use of this soil as range, either for grazing or haying, is highly effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover and deteriorate the native plant community. In addition, grazing the soil when wet causes surface compaction and hummocks and makes grazing or harvesting for hay difficult. Proper use, timely deferment of grazing or haying, and restricted use during wet periods help to maintain the plant community and soils in good condition.

This soil is generally suited to field windbreaks, feedlot windbreaks, range or livestock windbreaks, and plantings in recreation or wildlife areas. Survival and growth of trees and shrubs is good if the species selected can tolerate occasional wetness. Establishing seedlings can be difficult in wet years. The abundant and persistent herbaceous vegetation that grows on this soil is a limitation in establishing and maintaining trees.

This soil has severe limitations for dwellings because of the hazards of occasional flooding and wetness. Houses should not be located in this area unless protected by pilings or fill material. Limitations are severe for onsite sanitary disposal systems because of wetness and flooding. Alternate sites should be selected or the area protected from flooding and the depth of suitable soil material above the water table increased. Roads are not suited to this soil because flooding, wetness, and severe frost action are severe limitations. Using artificial drainage and elevated roadbeds to prevent flooding may be possible for access roads. The roadbed can be mixed with other materials or additions to reduce frost action.

Capability unit IIw-6 dryland, IIw-8 irrigated; Subirrigated range site; windbreak suitability group 2.

PaC—Paka fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. Slopes are long and plane in some places and undulating in others. This soil is in areas where loamy eolian material has been deposited over siltstone sediments. Individual areas range from 5 to 50 acres.

Typically the surface layer is dark grayish brown, very friable fine sandy loam about 9 inches thick. It ranges from 8 to 14 inches in thickness in most areas. The subsoil is about 18 inches thick. The upper part is brown, friable sandy clay loam, and the lower part is light grayish brown, very firm clay loam. The underlying material to a depth of 46 inches is light gray silt loam. To 60 inches it is bedded siltstone. In some places the surface layer is loamy fine sand or loam. In some places the sandy surface layer is thicker than is typical.

Included with this soil in mapping are some small areas of Anselmo, Dunday, Onita, and Reliance soils. Anselmo and Dunday soils are on higher knobs and ridges. Onita and Reliance soils are above the Paka soil on the landscape. Included soils make up 10 to 15 percent of the mapped areas.

This soil has moderate permeability. The available water capacity is high. Runoff is medium. The shrink-swell potential is low. The organic-matter content is moderate, and natural fertility is medium. This soil releases moisture readily to plants. It generally has good tilth and is easily tilled.

Most of the acreage is in cultivated crops. A few small areas are still in native grass.

The soil has fair potential for the commonly grown cultivated crops and for pasture and range. It has good potential for tree plantings in windbreaks and for rangeland wildlife habitat. It has fair potential for irrigated crops and for openland habitat and good potential for most recreational uses. It has fair potential for most engineering uses.

This soil is suited to dryland corn, oats, grain sorghum, and alfalfa. Soil blowing and water erosion are the main hazards. Gully erosion is a hazard in waterways. Conservation tillage, which leaves crop residue on the surface, along with terraces, contour farming, stripcropping, and grassed waterways help in controlling water erosion. Shelterbelts along field boundaries help to control soil blowing. A cropping system that follows row crops with close-growing crops and uses tillage operations that leave most of the crop residue on the surface also helps to conserve moisture and control soil blowing.

Under irrigation, this soil is best suited to corn and alfalfa. Other crops commonly grown in the county are also suited. On the lower slopes, gravity systems that use contour furrows or borders can be used. On higher more irregular slopes, sprinklers are needed. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

The use of this soil for pasture or range is highly effective in controlling soil blowing or water erosion. Overgrazing the range or pasture reduces the protective cover and deteriorates the plant community. Proper use and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is well suited to field windbreaks, farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. Only tree and shrub species that tolerate slightly sandy, somewhat droughty conditions are suited. Lack of moisture and severe soil blowing are the principal hazards in establishing trees. The risk of soil blowing can be reduced by maintaining strips of sod or other vegetation between the rows.

This soil has moderate limitations for dwellings because of moderate shrink-swell action. It may be possible to replace abutting soil material with readily available material of low clay content and low shrink-swell properties. The moderate permeability of this soil can hinder proper functioning of septic tank absorption fields, but this problem can generally be overcome by increasing the size of the absorption area. Slope and seepage are moderate limitations for sewage lagoons. Sealing the bottom of the lagoon with slowly permeable material or selecting an alternate site may be needed. Cuts and fills can be used to modify slope. Construction of local roads and streets is severely limited because of low strength. This can be corrected by strengthening or replacing the base material.

Capability unit IIIe-3 dryland, IIIe-5 irrigated; Sandy range site; windbreak suitability group 3.

Ph—Paka loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil has uniform smooth slopes. Individual areas are generally irregular in shape and range from 5 to 100 acres.

Typically the surface layer is dark gray, friable loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part is grayish brown, firm silty clay loam; the middle part is pale brown, firm silty clay loam; and the lower part is light brown, friable silt loam. The underlying material to a depth of 40 inches is pinkish gray, friable silt loam. To 60 inches it is weakly cemented siltstone. In some places a soil that is similar to this Paka soil but has a surface layer thicker than 20 inches is included in the unit. In some areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Anselmo, Blendon, Onita, and Reliance soils. All of these soils are above the Paka soil on the landscape. They make up 5 to 10 percent of the mapped areas.

This soil has moderate permeability and high available water capacity. The shrink-swell potential is moderate. The organic-matter content is moderate, and natural fertility is medium. This soil is easily worked. Surface runoff is slow.

Almost all of the acreage is cultivated. A few small isolated areas are still in native grassland.

The soil has good potential for the commonly grown dryland and irrigated crops. It has fair potential for pasture and range and good potential for windbreak plantings and openland and rangeland wildlife habitat. It has fair to good potential for recreational facilities and fair potential for most engineering uses.

This soil is well suited to all of the dryland crops grown in the county. Corn, alfalfa, sorghum, oats, and tame grasses are the main crops. Insufficient rainfall is a concern. The soil is slightly susceptible to water erosion. Soil blowing can be a hazard unless protection is adequate. Crop residue kept on the surface during tillage reduces evaporation and increases moisture intake. Stripcropping and returning crop residue reduce the hazard of soil blowing.

Under irrigation, corn is the major crop, but alfalfa, grain sorghum, and tame grasses are also suited. Maintaining fertility and managing water are the main concerns. Suitable irrigation systems are borders, furrows, and sprinklers. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

This soil is well suited to range, which is effective in controlling erosion. Overgrazing, however, reduces the protective cover and deteriorates the potential native plant community. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is well suited to field windbreaks, farmstead windbreaks, range and livestock windbreaks, and plantings in recreation and wildlife areas. All tree and shrub species that are moderately drought tolerant are suited. Moisture competition is a principal hazard.

This soil has moderate limitations for dwellings, septic tank absorption fields, and sewage lagoons. Foundation and basement walls should be designed to withstand the shrinking and swelling actions of the soil. Replacing the abutting soil material with material of little or no clay content may be possible. Increasing the length of septic tank absorption fields may be needed because of moderate permeability. The bottom of sewage lagoons should be sealed to prevent seepage. For local roads and streets, special designs to overcome low strength are needed, which may require replacement or modification of soil material.

Capability unit IIc-1 dryland, I-4 irrigated; Silty range site; windbreak suitability group 4.

PhC—Paka loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on broad drainage divides on uplands. Slopes are plane and slightly convex. Areas range from 5 to 50 acres.

Typically the surface layer is dark grayish brown, friable loam about 12 inches thick. The subsoil is firm silty clay loam about 16 inches thick. The upper part is brown, and the lower part is very pale brown. The underlying material is very pale brown, firm silt loam to a depth of 40 inches. To 60 inches it is weakly cemented siltstone. In some places the surface layer is silt loam or fine sandy loam.

Included with this soil in mapping are small areas of Anselmo, Onita, Ree, and Reliance soils. All of these soils are higher on the landscape than this Paka soil. They make up 10 to 15 percent of the mapped areas.

This soil has moderate permeability and high available water capacity. Shrink-swell potential is moderate. The organic matter content is moderate, and the natural fertility level is medium. Surface runoff is medium. This soil is easily worked and generally has good tilth.

Almost all the acreage is cultivated. This soil has fair potential for all dryland and irrigated crops. It has fair potential for range, pasture, and openland wildlife habitat. It has good potential for windbreak plantings and rangeland habitat. It has fair to good potential for recreational facilities and fair potential for most engineering uses.

This soil is suited to all the crops commonly grown in the county. Under dryland management, corn, alfalfa, sorghum, small grain, and tame grasses are grown. This soil is moderately susceptible to water erosion and slightly susceptible to soil blowing if it is not adequately protected. Conservation tillage, which leaves crop residue on the surface, along with terracing, can control the risk of erosion and conserve moisture in areas that are cultivated year after year.

If irrigated, this soil is well suited to alfalfa and grasses. Corn and grain sorghum are suited if erosion control methods are used. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

Sprinklers are most suitable for irrigating this soil. A gravity system requires heavy grading and terraces or benches to achieve uniform distribution of water and control of erosion.

This soil is also suited to range and pasture, which are effective in controlling water erosion and soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover and deteriorate the potential native plant community. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for planting trees in field windbreaks, farmstead and feedlot windbreaks, range or livestock windbreaks, and recreation or wildlife areas. The survival and growth of moderately drought resistant trees and shrubs are good. Drought and competition from weeds and grasses for moisture are the principal hazards. Water erosion is also a hazard. Proper site preparation and timely cultivation are needed for seedlings to survive.

This soil has moderate limitations for dwellings because of the moderate shrink-swell potential. The soil material abutting foundations and basement walls should be replaced with material of low clay content. The length of septic tank absorption lines may have to be increased because of moderate permeability. For sewage lagoons, the bottom should be sealed to prevent seepage, and altering the slope may be needed. For local roads and streets special designs may be required because of low strength. Replacement or modification of soil base material may be needed.

Capability unit IIIe-1 dryland, IIIe-4 irrigated; Silty range site; windbreak suitability group 4.

PhD—Paka loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on upper side slopes of drainage divides on uplands. Individual areas are 15 to 60 acres.

Typically the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 18 inches thick. The upper part is light brownish gray, firm clay loam; the middle part is pale brown, very firm clay loam; and the lower part is light gray, very firm silty clay loam. The underlying material to a depth of about 48 inches is very pale brown, friable silt loam. To 60 inches it is very pale brown, weakly cemented siltstone. In some places the surface layer is silt loam or fine sandy loam. In a few places the unweathered siltstone occurs at depths less than 40 inches.

Included with this soil in mapping are small areas of Anselmo, Mariaville, Meadin, O'Neill, and Reliance soils. Anselmo, Meadin, O'Neill, and Reliance soils are above the Paka soil on the landscape. Mariaville soils are below the Paka soil on the landscape. Included soils make up 15 to 20 percent of the mapped areas.

This soil has moderate permeability and high available water capacity. Runoff is medium to rapid. The organic-matter content is moderate, and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. It is easily worked and generally has good tilth.

About 70 percent of the acreage is cropland. The rest is in native grass.

The soil has poor potential for dryland crops and fair potential for openland wildlife habitat, recreational facilities, and most engineering uses. It has fair potential for pasture and range and good potential for most tree plantings and for rangeland wildlife habitat. It has fair potential for irrigated crops.

This soil is poorly suited to dryland crops. Alfalfa, grasses, and close sown crops are better suited than corn and sorghum. Water erosion is the main hazard. Terracing, contour farming, and grassed waterways can be used on the smooth, regular slopes. On irregular slopes an alternative is the use of close-growing crops, tame grasses, or range. Row crops should be limited in the cropping sequence in order to reduce soil loss and maintain good tilth. Using a conservation tillage system in planting row crops or close-growing crops helps to reduce soil loss from erosion.

This soil is generally not well suited to irrigation. Because of the severe hazard of erosion, installing the structures needed to control water and hold soil loss to a minimum is not practical. If sprinklers are used, an extensive cropping system that includes mechanical, vegetative, and management practices is needed to control erosion. Close-sown crops, such as small grain, alfalfa and grass, are best suited to irrigation.

This soil is well suited to pasture and range, which are highly effective in controlling water erosion and soil blowing. Growing introduced cool season grasses in one area and warm season grasses in another can provide a longer grazing season for livestock. Cool season grasses should be fertilized to promote good growth. Overgrazing or improper haying methods reduce the protective cover, thus deteriorating the potential native plant community and resulting in severe soil losses through water erosion. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil generally provides good sites for planting trees in farmstead and livestock windbreaks. Survival is

good and growth fair for adapted species. Drought and moisture competition from weeds and grasses are the main limitations. Water erosion is a hazard. On steeper soils, the lack of sufficient moisture caused by rapid runoff reduces growth of trees. Proper site preparation and timely cultivation are needed for seedlings to survive.

This soil has moderate limitations for dwellings because of slope and moderate shrink-swell potential. Excavations and fills may be needed to provide suitable sites. Replacement or modification of backfill or abutting material may be needed. Because of slope and moderate permeability, septic tank absorption field trenches must be constructed approximately on the contour so that effluent flows slowly through the tile and is dispersed properly over the filter field. Limitations for sewage lagoons are severe because of slope. Alternate sites should be selected. Limitations for local roads and streets are severe because of moderate shrink-swell and low strength. Modification of subgrade material may be needed.

Capability unit IVe-1 dryland, IVe-4 irrigated; Silty range site; windbreak suitability group 4.

PoC—Promise silty clay, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands, colluvial fans, and terraces. The soil areas occur on the long, smooth lower side slopes where the accumulation of sediments from dark clay shales is thickest. Areas range from 5 to 60 acres.

Typically the surface layer is dark gray, friable silty clay about 9 inches thick. It ranges from 7 to 10 inches in thickness in most areas. The subsoil has prismatic structure and is extremely hard when dry. It is about 24 inches thick. The upper part is dark grayish brown silty clay, and the lower part is gray to olive gray clay that contains accumulations of carbonates in places. The underlying material, below a depth of 33 inches, is olive clay and silty clay. The lower, flatter areas have a thicker surface layer. In some places, the subsoil contains less clay than is typical.

Included with this soil in mapping are small areas of Boyd and Labu soil, which are on slightly higher convex slopes. They make up about 10 to 15 percent of each mapped area.

Permeability is slow and very slow except after dry periods, when initial intake in cracks is rapid. Surface runoff is medium. The available water capacity is moderate. The shrink-swell potential is high. Reaction is mildly alkaline in the surface layer and moderately alkaline in the underlying material. The organic-matter content is moderate, and natural fertility is medium. The soil generally does not have good tilth. It puddles if tilled when wet.

Most of the acreage is farmed. Some small odd areas are still in native range.

This soil has only fair potential for row crops and for grass, legumes, and range. It has fair potential for openland and rangeland wildlife habitat and for recreational facilities and poor potential for most engineering uses. It has poor potential for windbreak plantings. Potential pond reservoir sites are plentiful.

This soil is moderately well suited to cultivated crops, pasture, and hayland. Small grain and grain sorghum are more suitable than corn. Alfalfa produces well in years when moisture is plentiful, but produces only one cutting of hay and a seed crop in years when moisture is not ample. Because this clayey soil is not very permeable and the intake rate is slow, water tends to run off and cause erosion. Intertilled crops offer little protection from water erosion. Stubble mulch tillage and the return of crop residue help to prevent serious water erosion and soil blowing. A cropping system that returns a large amount of organic matter to the soil improves structure and increases water intake. Areas that have long smooth slopes should be terraced and farmed on the contour. Grassed waterways are needed in some drainageways to help carry water from adjacent higher slopes and prevent flooding and erosion.

Using this soil as range or hayland is effective in controlling erosion. Overgrazing and overstocking the range, however, reduce the protective plant cover and cause erosion. Proper stocking rates and a planned grazing system help to keep the grasses in good condition.

The soil is poorly suited to field windbreaks and only fairly suited to farmstead windbreaks, livestock protection windbreaks, and plantings in wildlife and recreation areas. Because of the high clay content of the soil, the suitable species of trees and shrubs are limited to those that are extremely drought tolerant.

This soil has severe limitations for dwellings. The main problems are the high shrink-swell potential and inadequate strength for supporting loads. Basement walls, foundations, and footings for dwellings and small buildings should be properly designed to prevent structural damage caused by shrinking and swelling. Drainage tiles around the buildings should be used to keep the soil from becoming saturated. The very slow permeability is a problem for proper functioning of septic tank filter fields. The filter field should be designed taking the permeability into consideration. Slope is a moderate limitation for sewage lagoons. For onsite waste disposal, cutting and filling to modify the slope should be done where possible.

The construction of local roads also is severely limited by the high shrink-swell potential and the low support strength of this soil. Grading to shed water and using suitable base material from outside the area are needed.

Capability unit IIIe-4; Clayey range site; windbreak suitability group 9.

RaC—Ree silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on smooth, slightly convex, wide ridgetops that are drainage divides. Individual areas range from 10 to 150 acres.

Typically the surface layer is friable, dark grayish brown silt loam about 7 inches thick. The subsoil is about 18 inches thick. The upper part is firm, dark brown silty clay loam, and the lower part is grayish brown light clay loam. The underlying material to a depth of about 60 inches is grayish brown sandy loam in the upper part and pale brown, loamy fine sand in the lower part. In some places the surface layer is fine sandy loam or loam.

Included with this soil in mapping are small areas of Anselmo, Onita, and Reliance soils. The Anselmo soils are on the tops of knolls and ridges. The Onita and Reliance soils occupy the lower flatter side slopes and swales. These included areas make up 10 to 20 percent of each mapped area.

This soil has moderate permeability. Runoff is medium. The available water capacity is moderate. The organic-matter content is moderate, and natural fertility is medium. Tilth is generally good, and the soil is easily tilled.

Most of the acreage is in cultivated crops. A few small areas are still in native grass.

The soil has fair potential for the commonly grown cultivated crops and for grass and range. It has good potential for openland and rangeland wildlife habitat and for windbreak plantings. It has fair to good potential for recreational facilities. It has fair potential for most engineering uses.

This soil is suited to corn, small grain, grain sorghum, and alfalfa and grasses for hay and pasture. Water erosion and soil blowing are hazards in areas used for intertilled crops. The risk of erosion can be controlled by terraces, contour farming, grassed waterways, and conservation tillage, which leaves most of the crop residue on the surface as a protective cover.

If this soil is irrigated, the conservation measures needed are the same as those needed in dryfarmed areas. Furrow and border irrigation methods can be used if the land is leveled intensively enough that water erosion and runoff are at a minimum. This soil is suited to contour bench leveling, but deep cuts may expose the sandy underlying material. Management that reduces or controls runoff of irrigation water at the ends of fields is needed.

Sprinklers are effective in irrigating this soil. Erosion control is needed. The rate of applying water should be carefully controlled so as not to exceed the intake rate of the soil.

The use of this soil for pasture or range is highly effective in controlling erosion. Overgrazing the range, however, reduces the protective cover and deteriorates the plant community. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil provides good planting sites for trees in field, farmstead, and livestock windbreaks. Windbreaks of adapted trees have good survival and fair growth if not subject to drought or competition from weeds and grasses for the available moisture. Proper site preparation and timely cultivation are needed for seedlings to survive.

This soil has fair suitability as a site for dwellings. The main limitations are the moderate shrink-swell potential and the low strength. Foundations and basement walls should be designed to withstand shrinking and swelling by replacing abutting material with readily available sandy material. Septic tank absorption fields should be larger than normal because of the slow percolation rate of the subsoil. If the sandy underlying material is not too deep, placing the field tile in this soil zone may be effective. Seepage and slope are moderate limitations for sewage lagoons. Lining the bottom of the lagoon with clay may be needed, and the slope can be modified by shaping. This soil has fair potential for local roads and streets. The road base needs strengthening to reduce frost action and shrink-swell.

Capability unit IIIe-1 dryland, IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

RaD—Ree silt loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on drainage divides of the uplands. It occurs in areas where sands are covered with thin layers of loess. Individual areas of this soil are 5 to 100 acres.

Typically the surface layer is friable, dark grayish brown silt loam about 7 inches thick. The subsoil is 15 inches of friable, grayish brown silty clay loam and 3 inches of grayish brown clay loam. The underlying material to a depth of 33 inches is pale brown, mildly alkaline, light clay loam. Below this it is pale brown, mildly alkaline sandy loam. In some places the surface layer is fine sandy loam, loam, or light silty clay loam. In a few areas the underlying sandy material occurs at a depth of less than 24 inches.

Included with this soil in mapping are small areas of Anselmo and Reliance soils. The Anselmo soils are near the top of the side slopes. The Reliance soils are on the lower side slopes. These included soils make up 10 to 20 percent of each mapped area.

This soil has moderate permeability. Runoff is medium. The available water capacity is moderate. The organic-matter content is moderate, and natural fertility is medium. The soil is easily worked and generally has good tilth.

Most of the acreage is in cultivated crops. A few small areas are still in native grass. The soil has fair potential for most crops commonly grown in the county. It has good potential for range, windbreaks, pasture, and wildlife habitat. It has fair potential for most engineering uses and for recreational facilities.

This soil is only fairly suited to dryland crops. Alfalfa, grasses, and close-sown crops are better suited than intertilled crops. Sheet and gully erosion are hazards if this soil is cultivated and the surface is not protected. Row crops or clean tilled crops should not follow each other in the cropping sequence. A cropping system that includes small grain, grasses, and alfalfa about 80 percent of the time helps in controlling erosion. In addition, terraces, contour farming, grassed waterways, and the use of crop residue in a conservation tillage system are needed.

These soils are generally not well suited to irrigation. Because of the severe hazard of erosion, installing the structures needed to control water and hold soil loss to a minimum is not practical. If sprinklers are used, water should be applied at a low rate so that it infiltrates the soil and does not become a source of runoff and erosion. Close-sown crops such as small grain, alfalfa, and grass are best suited to irrigation. The conservation practices needed are the same in irrigated and dryfarmed areas.

This soil is also suited to pasture and range. Growing introduced cool season grasses in one area and warm

season grasses in another can provide a longer grazing season for livestock. Cool season grasses need fertilization to promote good growth. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil generally provides good sites for windbreaks and plantings in wildlife areas. The survival and growth of suitable species is good if erosion control is practiced and competition for moisture from weeds and grasses is controlled.

This soil has moderate limitations for dwellings because of slope, shrink-swell, and low strength. Foundation and footings should be designed to withstand shrinking and swelling actions of the soil. Tile drains can be installed or, possibly, abutting soil material replaced with readily available material of little clay content. The slope can be modified by shaping. For septic tank absorption fields limitations are moderate because of slope and slow percolation. Larger than normal absorption fields and trench lines placed on the contour may be required. Sewage lagoons should be located on lower slopes. This soil is only fairly well suited to local roads. Special design is needed to overcome low strength, slope, and moderate shrink-swell.

Capability unit IVe-1 dryland, IVe-3 irrigated; Silty range site; windbreak suitability group 4.

RaE—Ree silt loam, 11 to 15 percent slopes. This deep, moderately steep, well drained soil is on loess uplands. It is on sharp ridgetops and convex hillsides of drainage divides. Areas range from 10 to 80 acres.

Typically the surface layer is about 8 inches thick. The upper part, the plow layer, is about 5 inches of friable, grayish brown silt loam, and the lower part is friable, dark grayish brown heavy silt loam. The subsoil is about 22 inches thick. In the upper 10 inches it is firm, brown silty clay loam, and in the lower 12 inches it is firm, pale brown sandy clay loam. It is moderately alkaline. The underlying material to a depth of 60 inches is very pale brown fine sandy loam that is mildly alkaline. In some areas the sandy underlying material is at a depth of less than 24 inches. In a few areas the surface layer is fine sandy loam or light silty clay loam.

Included with this soil in mapping are small areas of Anselmo and Reliance soils. The Anselmo soils are near the top of side slopes, and the Reliance soils are on the lower side slopes. These included soils make up 15 to 20 percent of each mapped area.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. The soil absorbs moisture easily and releases it readily to plants. It is easy to work. Runoff is rapid.

About two-thirds of the acreage is cultivated. The rest is in native range.

This soil has very poor potential for cultivated crops. It has fair potential for range. It has good potential for grass and trees and for wildlife habitat. It has poor potential for most engineering uses and for recreational facilities.

This soil is generally not suitable for cultivation because it is too steep. Those areas now cultivated can be established in pasture by planting cool or warm season grasses. If cool season grasses are managed separately from native or warm season grasses, they can provide season-long green grazing for livestock. Cover crops can be used to prepare the land before seeding grasses, which reduces erosion and eliminates competition from weeds for the new seedlings. In areas used for grazing, mowing helps to control weeds and undesirable plants. Many areas of this soil are small and isolated or are adjacent to surrounding cropland. These areas can be used for hay or grazing along with the crop aftermath.

This soil is suited to farmstead and feedlot windbreaks, range or livestock windbreaks, and plantings in recreation and wildlife areas. Only trees and shrubs that tolerate drought are suited. The low fertility, the lack of adequate moisture, and the water erosion hazard are the principal limitations.

This soil has only fair suitability as a site for dwellings and local roads. The main limitations are moderately steep slopes, moderate shrink-swell, and low strength. Foundations and footings for dwellings should be designed to withstand shrinking and swelling actions of the soil. Tile drains can be installed or, possibly, abutting soil material replaced with readily available material of low clay content. The slope can be modified by shaping. Slope and slow percolation are moderate limitations for septic tank absorption fields. Larger than normal absorption fields and trench lines placed on the contour may be required. Sewage lagoons should be located on lower slopes. In building local roads, special design is needed to overcome low strength, slope, and shrink-swell. Locating roads on the contour reduces the risk of erosion.

Capability unit VIe-1; Silty range site; windbreak suitability group 4.

ReC—Reliance silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on loess covered uplands. It occupies smooth, slightly convex, wide ridgetops that are drainage divides. Areas range from 5 to 300 acres.

Typically the surface layer is friable, very dark grayish brown silt loam about 10 inches thick. It ranges from 10 to 14 inches in thickness in most areas. The subsoil is about 24 inches thick. It is friable, dark grayish brown silty clay loam in the upper 4 inches and firm, brown silty clay loam in the lower 20 inches. The underlying material to a depth of 50 inches is yellowish brown, calcareous silt loam. Below this it is light yellowish brown fine sandy loam. In some places the substratum is clay, siltstone, or gravel. In a few areas the surface layer is sandy loam or silty clay loam.

Included with this soil in mapping are small areas of Ree soils on the rounded tops of the ridges. They make up 10 to 15 percent of each mapped area.

This soil has moderately slow permeability. Runoff is medium. The available water capacity is high. The organic-matter content is moderate, and natural fertility is

medium. The shrink-swell potential is high. This soil is easily worked and generally has good tilth. It is easily and deeply penetrated by roots.

Almost all the acreage is cultivated. The soil has only fair potential for all crops commonly grown in the county. It has good potential for openland and rangeland wildlife habitat and for tree plantings. It has fair potential for rangeland and recreational facilities and poor to fair potential for most engineering uses.

This soil is suited to dryland corn, small grain, grain sorghum, and alfalfa and grasses for hay and pasture. Water erosion and soil blowing are hazards in areas used for intertilled crops. The risk of erosion can be controlled by terraces, contour farming, grassed waterways, and conservation tillage, which leaves most of the crop residue on the soil surface as a protective cover.

If irrigated, this soil is well suited to alfalfa and grasses. Corn and grain sorghum are suited if erosion is controlled. The risk of erosion can be controlled by using terraces, grassed waterways, contour farming, and a conservation tillage system, which leaves crop residue on the surface.

Sprinklers are suitable for irrigating this soil. Slope makes control of water erosion resulting from rainfall and irrigation water difficult. The rate of applying water should be carefully controlled so as not to exceed the intake rate of the soil. Furrow and border irrigation can be used if the land is intensively leveled so that water erosion and runoff are at a minimum. Contour bench leveling is effective in controlling irrigation water. Management that controls runoff or reuses irrigation water at the end of the field is needed. The conservation practices needed are the same in irrigated and dryfarmed areas.

This soil is also suited to pasture and range. The hazard of water erosion can be reduced on rangeland by allowing part of the yearly growth of grass to remain after the grazing season.

This soil generally provides good sites for planting trees. Survival of suited species is good, and growth is fair. Erosion, drought, and competition for moisture from weeds and grasses are the principal hazards. Proper site preparation and timely cultivation are needed for seedlings to survive.

This soil has severe limitations for dwellings. The main problems are high shrink-swell potential and low strength. Foundations and footings should be designed to withstand shrinking and swelling actions of the soil. Tile drains can be installed or, possibly, abutting soil material replaced with readily available material of low clay content. Limitations are severe for septic tank absorption fields because of slow percolation. Larger than normal absorption fields may be needed. Slope is a moderate limitation for sewage lagoons, but slope can be modified by shaping. This soil is poorly suited to local roads. Low bearing strength and high shrink-swell are the main limitations. Replacement or modification of the soil material may be necessary.

Capability unit IIIe-1 dryland, IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

ReD—Reliance silt loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is in the loess uplands on slightly convex drainage divides. The areas are generally long and narrow and follow the pattern of drainageways. They are 10 to 90 acres.

Typically the surface layer is friable, brown silt loam. It is neutral in reaction. It is generally about 12 inches thick but ranges from 10 to 14 inches in most areas. The subsoil is firm, light yellowish brown, mildly alkaline silty clay loam about 16 inches thick. The underlying material to a depth of 52 inches is light yellowish brown, moderately alkaline silt loam. Below this it is light yellowish brown to light olive brown fine sandy loam. In a few places the surface layer is sandy loam or silty clay loam. In some places the substratum is clay or siltstone.

Included with this soil in mapping are small areas of Ree soils on tops of ridges. They make up 10 to 15 percent of each mapped area.

This soil has moderately slow permeabilty. Runoff is medium. The available water capacity is high. The organic-matter content is moderate, and the natural fertility level is medium. The shrink-swell potential is high. This soil is generally easy to work and has good tilth. It is easily penetrated by roots.

Most of the acreage is cultivated. Some small areas are still in native range.

The soil has fair potential for most crops commonly grown in the county. It has fair potential for wildlife habitat and good potential for range and pasture. It has fair to poor potential for recreational facilities and poor potential for most engineering uses.

This soil is moderately well suited to dryland crops. Alfalfa, grasses, and close-sown crops are better suited than intertilled crops. Sheet and gully erosion are hazards if this soil is cultivated and the surface is not protected. Row crops, or clean tilled crops, should not follow each other in the cropping sequence. A cropping system that includes small grain, grasses, and alfalfa about 80 percent of the time helps in controlling erosion. In addition to crop rotation, terraces, contour farming, grassed waterways, and the use of crop residue in a conservation tillge system are needed.

This soil is generally not well suited to irrigation. Border and furrow irrigation are not suited because the severe hazard of erosion makes installing water control structures impractical. Only sprinklers are suited. Water should be applied at a low rate so that it infiltrates the soil and does not become the source of runoff and erosion. Because of the extreme hazard of erosion, the only crops suited to irrigation on this soil are close-sown crops, such as small grain, alfalfa, and grass. The conservation practices needed to control erosion are the same in irrigated and dryfarmed areas.

This soil is also well suited to permanent grass and hay. Growing introduced cool season grasses in one area and warm season grasses in another can provide a longer grazing season for livestock. Cool season grasses should be fertilized to promote good growth. The use of grass is

effective in controlling erosion. Proper stocking and a planned grazing system help to keep the grasses in good condition.

This soil provides good sites for planting trees. Windbreaks of adapted trees have good survival and fair growth if they are not subjected to drought or competition from weeds and grasses for available moisture. Proper site preparation and timely cultivation are needed. Water erosion control measures may be needed.

This soil has severe limitations for dwellings because of high shrink-swell potential, low strength, and slope. Foundations and footings should be designed to withstand shrinking and swelling actions of the soil. Tile drains can be installed or, possibly, abutting soil material replaced with readily available material of little clay content. The slope can be modified by shaping. Slow percolation is a severe limitation for septic tank absorption fields. Larger than normal absorption fields and trench lines constructed on the contour may be required. Slope is a severe limitation for sewage lagoons. Lagoons should be located on lower slopes. This soil is poorly suited to local roads. Special design is needed to overcome low strength and high shrink-swell.

Capability unit IVe-1 dryland, IVe-3 irrigated; Silty range site; windbreak suitability group 4.

RfC—Reliance silty clay loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on loess covered uplands. Slopes are plane or slightly convex. Areas range from 5 to 60 acres.

Typically the surface layer is friable, dark grayish brown silty clay loam about 7 inches thick. It is neutral in reaction. The subsoil is about 27 inches thick. It is firm, dark brown, neutral silty clay loam in the upper 7 inches; firm, brown, mildly alkaline silty clay in the next 9 inches; firm, brown, mildly alkaline silty clay loam in the next 4 inches; and friable, grayish brown, calcareous silty clay loam in the lower 7 inches. The underlying material to a depth of 60 inches is light grayish brown light silty clay loam. Reaction is moderately alkaline. In a few areas shale occurs within a depth of 40 inches.

Included with this soil in mapping are small, nearly level areas of Onita soils. They make up less than 15 percent of the mapped acreage.

This soil has moderately slow permeability. Runoff is medium. The available water capacity is high. The organic-matter content is moderate, and natural fertility is medium. The shrink-swell potential is high. Reaction is neutral in the surface layer and moderately alkaline in the underlying material. The soil has fair workability. It tends to become cloddy if tilled when wet.

Almost all the acreage is cultivated. The soil has fair potential for most crops grown in the county and fair potential for pasture and range. It has good potential for planting trees and good potential for openland and rangeland wildlife habitat. It has fair potential for recreational facilities and poor potential for most engineering uses.

This soil is suited to dryland corn, small grain, grain sorghum, and alfalfa and grasses for hay and pasture. Water erosion is a hazard in areas used for intertilled crops. The risk of erosion can be reduced by using terraces, contour farming, grassed waterways, and a conservation tillage system, which leaves most of the crop residue on the soil surface as a protective cover.

Under irrigation, corn and alfalfa are the main crops. Grasses for pasture also are well suited. Furrow, border, and sprinkler irrigation are suitable. Land leveling is needed for border or furrow irrigation. Bench leveling is a good way to control the furrow grade and thus control erosion. Where this soil is irrigated by sprinklers, the rate of applying water should be carefully controlled so as not to exceed the intake rate of the soil. Erosion can be controlled by using the same conservation practices that are used in dryfarmed areas. Control of insects and plant diseases is also needed.

This soil is also suited to pasture and range. On range, the hazard of water erosion can be reduced by allowing a part of the yearly growth of grass to remain after the grazing season.

Windbreaks on this soil have good survival and growth if they are not subjected to drought or to excessive competition from weeds and grasses for the available moisture. Proper site preparation and timely cultivation are needed for seedlings to survive.

This soil has severe limitations for dwellings. Foundations and basement walls should be designed to withstand shrinking and swelling actions of the soil. Replacing the back fill material with material having low clay content may be necessary. Tile drains to help keep the abutting material dry can also be used. Slow percolation is a severe limitation for septic tank absorption fields. Larger than normal absorption fields may be needed. Limitations for sewage lagoons are moderate because of slope, but the slope can be modified by shaping. This soil is poorly suited to local roads. Low bearing strength and high shrink-swell are the main limitations.

Capability unit IIIe-1 dryland, IIIe-3 irrigated; Silty range site; windbreak suitability group 4.

Rw—Riverwash. This map unit consists of nearly level, very poorly drained, unstabilized sandy sediments stratified with silty and clayey material. Areas occur as sandbars and islands in the major rivers. They are flooded and washed and reworked by the river so frequently that they support little or no vegetation. The seasonal high water table fluctuates between the surface and a depth of 1 foot. Areas range from 5 to 60 acres.

Included with this unit in mapping are small areas of Barney soils, a few areas, higher in elevation than areas of Riverwash, that support a few willows, cottonwood trees, common reedgrass and annual weeds, and a few areas that have a darkened surface layer 2 to 4 inches thick. The poorly drained Barney soils also are higher in elevation than the Riverwash. These included areas make up 15 to 20 percent of each mapped area.

Most of the acreage is used as habitat for wildlife.

Capability unit VIIIw-7; not assigned to a range site; windbreak suitability group 10.

SaG—Sansarc silty clay, 20 to 40 percent slopes. This shallow, well drained, steep and very steep soil is on uplands. It is on narrow convex ridges, sharp slope breaks, and the upper sides of some drainageways. Individual areas are generally irregular in shape and range from 20 to 200 acres.

Typically the surface layer is a friable, dark grayish brown silty clay about 5 inches thick. The underlying material is grayish brown to light olive gray shaly clay about 11 inches thick. Pale olive bedded shale is at a depth of about 16 inches.

Included with this soil in mapping are small areas of Boyd and Labu soils. They occupy the broader convex ridgetops and lower side slopes where the depth to shale is more than 20 inches. They make up 15 to 20 percent of each mapped area.

Permeability of this soil is slow. Surface runoff is very rapid, and the available water capacity is very low. The organic-matter content is low, and natural fertility is low. Reaction is moderately alkaline throughout the soil. The root zone extends to shale bedrock.

Nearly all areas of this soil are in native grass and are used for grazing. This soil has poor potential for range and rangeland wildlife habitat. It has very poor potential for farming, tree and shrub plantings, and most engineering uses. It has poor potential for recreational facilities.

This unit is best suited to range. Control of water erosion is the main management problem. Gullies form quickly if the native vegetation is destroyed or is in poor condition. Proper use of the range is the only practical way to control erosion. Proper stocking rates, uniform grazing distribution, deferred grazing, and a planned grazing system help to keep the range in good condition.

This soil is not suited to dwellings because of the steep slopes and the unstable nature of the shales, which cause slipping during periods of excessive moisture. Alternate sites should be selected. Suitable sites for sanitary disposal systems, pond reservoirs, and local roads should be located on the deeper, less sloping soils on foot slopes or on the broader ridgetops.

Capability unit VIIs-4; Shallow Clay range site; windbreak suitability group 10.

Sc—Scott silt loam, 0 to 1 percent slopes. This nearly level, very poorly drained soil is in depressions of the loess-mantled uplands. Areas range from 5 to 50 acres.

Typically the surface layer is friable silt loam about 8 inches thick. The upper part is dark grayish brown and the lower part is gray. The subsoil is gray, very firm silty clay about 40 inches thick. The substratum is light grayish brown, very firm silty clay loam to a depth of about 56 inches and pale brown clay loam to 64 inches. In some areas the soil has accumulated several inches of washed-in silt, so that the silt loam surface layer is thicker than is typical. In others flooding is not so frequent as is typical.

Included with this soil in mapping are small areas of Onita soils. These soils are generally higher on the landscape than this Scott soil. They make up less than 5 percent of the total acreage.

This soil has very slow permeability and high available water capacity. Runoff is ponded. This soil absorbs water slowly and because of the clayey subsoil releases it slowly to plants. The subsoil becomes very hard when dry. The soil is ponded during some parts of the year and commonly is dry during others. It is difficult to work because it is either too wet or too hard, and it is difficult to keep in good tilth. The shrink-swell potential is low in the surface layer, high in the subsoil, and moderate in the underlying material. The organic-matter content is commonly moderately low, and the natural fertility level is medium. Frequent flooding is a serious hazard.

Most of the acreage is grassland. Some of the lowest areas in the depressions that are most frequently flooded are in annual weeds and grasses, perennial weeds such as smartweed, or are barren. Some areas, which have been drained or protected from flooding, are cultivated.

This soil has good potential for wetland wildlife. It has fair potential for pasture and range. Potential is poor for crops, very poor for windbreaks, and poor for openland and rangeland wildlife, recreational facilities, and most engineering uses.

This soil is generally poorly suited to crops unless some protection is given from wetness and the serious hazard of flooding. The choice of crops is restricted. Winter wheat and forage sorghum are somewhat suited because they do not require tillage early in spring. Tame grass is also suited. Constructing terraces in adjacent higher areas reduces the risk of flooding from run-in water. Constructing pits or dug-outs in the lowest part of the depression helps to concentrate run-in water in a small area and to dry the soil. Drainage outlets are generally not available. Where artificial drainage is used drop structures are generally needed to prevent cut back erosion. Returning crop residue to the soil and not tilling when the soil is wet help to maintain good tilth. This soil is not suited to irrigation.

This soil is commonly used for range, but forage yields are poor because of the frequency and duration of floods. The soil can be seeded to flood-tolerant grasses, which improves production. Overgrazing and silt deposition reduce the protective cover and deteriorate the plant community. Grazing when the soil is wet causes surface compaction and hummocks, which make grazing and harvesting for hay difficult.

This soil is not suited to trees. It can be developed for recreation, such as hunting wildfowl, and it is used by wildlife. It is not a suitable site for buildings or sanitary disposal facilities. Alternate sites should be selected.

Capabilty unit IVw-2 dryland; not assigned to a range site; windbreak suitability group 10.

Sm—Simeon loamy sand, 0 to 2 percent slopes. This deep, nearly level, excessively drained soil is on sandy geologic terraces. Individual areas range from about 40 to 300 acres.

Typically the surface layer is very friable loamy sand about 10 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. The transi-

tion layer is brown, very friable loamy coarse sand about 6 inches thick. The underlying material is a brown, loose, loamy coarse sand to a depth of 34 inches; a light yellowish brown coarse sand to 42 inches; and very pale brown, loose sand to 60 inches. In some places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Dunday, O'Neill, and Valentine soils. O'Neill soils are commonly at lower levels on the landscape than this Simeon soil. Dunday soils also are at slightly lower elevations, and Valentine soils are generally higher on the landscape. These included soils make up 5 to 15 percent of each mapped area.

Permeability of this soil is rapid, and available water capacity is low. Surface runoff is slow. The organic-matter content and natural fertility are low. If it is overgrazed or left bare, soil blowing is a severe hazard. Grass grows poorly because of the low available water capacity.

Almost all the acreage is native rangeland. A few areas are cultivated, mostly under sprinkler irrigation.

This soil has very poor potential for dryland cultivated crops and for tree plantings. It has poor potential for openland wildlife habitat and fair potential for rangeland wildlife habitat. It has poor potential for irrigated crops, pasture, and range and fair potential for most recreational facilities. It has fair to good potential for most engineering uses.

This soil is best suited to grasses and is used principally as range, which is highly effective in controlling soil blowing. Overgrazing, however, reduces the protective cover and deteriorates the potential plant community. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is not suited to dryland cultivation because it is too droughty and erodible. For irrigation, sprinklers are most suitable. Center-pivot sprinklers are particularly well suited. Frequent application of water is needed. Tame grasses and small grain are the most suitable irrigated crops. If good management is practiced, corn, grain sorghum, and alfalfa also can be grown. Soil blowing and maintaining productivity are the principal management concerns. Maintaining a large amount of crop residue on the surface in winter and after tillage and planting helps to control soil blowing and maintain fertility.

This soil generally is not suited to windbreak plantings because it is very droughty and soil blowing is a severe hazard. Some areas can be used for recreation, forestation, and wildlife plantings of tolerant tree and shrub species if special approved practices are used.

This soil has slight limitations as a site for buildings and septic tank absorption fields. Cutbanks of shallow excavations are not stable and may cave. Protection should be provided or cutbanks sloped to provide stability. Seepage is a severe limitation for sewage lagoons. The lagoon can be sealed with impervious material or an alternate site selected.

Capability unit VIs-4 dryland, IVs-14 irrigated; Shallow to Gravel range site; windbreak suitability group 10.

SuC—Simeon-Valentine loamy sands, 0 to 6 percent slopes. This map unit consists of deep, excessively drained, nearly level to gently sloping soils. Slopes are complex. They range from nearly level to undulating sand dunes. Individual areas range from 10 to 100 acres. They are 50 to 60 percent Simeon soil and 40 to 50 percent Valentine soil. The Simeon soil is on the smooth to slightly convex slopes. The Valentine soil makes up the convex undulating sand dunes. Areas of the two soils are so intricately mixed or so small in size that it was not practical to map them separately at the scale selected.

Typically the Simeon soil has a surface layer of grayish brown, very friable loamy sand about 6 inches thick. The transition layer is brown, very friable loamy coarse sand about 6 inches thick. The underlying material is light yellowish brown, loose coarse sand to a depth of 27 inches and very pale brown coarse sand to 60 inches. In places the surface layer is loamy fine sand.

Typically the Valentine soil has a surface layer of dark grayish brown very friable loamy sand about 7 inches thick. The transition layer is brown, loose fine sand about 6 inches thick. The underlying material is light yellowish brown to pale brown fine sand. In places the surface layer is fine sand.

Included with this unit in mapping are small areas of Dunday and O'Neill soils. These soils generally are lower on the landscape than the Valentine soil, in positions similar to those of the Simeon soil. The included soils make up 5 to 15 percent of the total mapped acreage.

Permeability of these soils is rapid, runoff is slow, and available water capacity is low. The natural fertility and the organic-matter content are low. These soils are droughty. If they are overgrazed or left bare, soil blowing is a severe hazard.

Most areas of this unit are still in native grass and are used for grazing. A few small areas are irrigated and planted to cultivated crops.

The soils in this unit have fair to poor potential for dryland crops and rangeland; poor potential for irrigated crops; very poor to fair potential for windbreaks; and fair potential for rangeland wildlife habitat, recreational facilities, and most engineering uses.

This map unit is best suited to range, which is highly effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition. Small blowouts, which are subject to soil blowing, can be converted to range by shaping and fencing to exclude livestock and then mulching and reseeding.

These soils are generally not suited to dryland cultivated crops. Those areas that are now cultivated or have been left to go back to weeds and annual grasses

can be seeded to warm season native grasses. In establishing range seeding, such practices as proper seedbed preparation, use of cover crops and adapted seed, and adequate weed control measures are needed.

Under irrigation, tame grasses, small grain, and alfalfa are the most suitable crops. If good management practices are used, corn and grain sorghum also can be grown. Sprinkler irrigation is better suited than other methods. Center-pivot sprinklers are particularly well suited. Frequent application of water is needed. Maintaining a large amount of crop residue on the surface in winter and after tillage and planting helps to control soil blowing and maintain fertility.

Generally these soils are too droughty and too sandy to provide good sites for windbreak plantings. Areas that are dominantly Valentine soils can be used for limited plantings. Some areas can be used for recreation, wildlife, and forestation plantings of drought tolerant tree or shrub species if special approved practices are used.

Soils in this unit provide good sites for dwellings, local roads and streets, and septic tank absorption fields. Caving is a problem for shallow excavations. Cutbanks should be sloped or protected for stability. Limitations for sewage lagoons are severe because of slope and seepage into groundwater. The lagoons can be sealed with impervious material, and the slope can be modified by shaping. Limitations for most recreation facilities are moderate because the soils are too sandy.

Capability unit VIs-4 dryland, IVs-14 irrigated; Simeon soil in Shallow to Gravel range site, windbreak suitability group 10; Valentine soil in Sands range site, windbreak suitability group 7.

SvF2—Simeon-Valentine complex, 3 to 30 percent slopes, eroded. This map unit consists of gently sloping to steep, excessively drained soils. The steep areas are erodible and are characterized by many sand washes and gullies. These soils are on the upper side slopes and narrow ridgetops of drainageways along Ponca Creek and the Keya Paha and Niobrara Rivers. Individual areas range from 40 to more than 1,000 acres. They are 65 percent Simeon soil and 25 percent Valentine soil. Areas of the two soils are so intermingled that it was not practical to map them separately at the scale selected.

Typically the Simeon soil has a surface layer of dark grayish brown, very friable loamy sand about 5 inches thick. There is an intermediate layer of brown, loose loamy coarse sand about 5 inches thick. The underlying material to a depth of 60 inches is very pale brown, loose coarse sand.

Typically the Valentine soil has a surface layer of grayish brown, loose fine sand about 6 inches thick. The next layer is brown, loose fine sand about 3 inches thick. Below this is pale brown, loose fine sand to a depth of 60 inches.

Included with these soils in mapping are small areas of Dunday, Labu, and Mariaville soils. Dunday soils are above this unit on the landscape. Labu and Mariaville soils are on lower side slopes. Included soils make up as much as 15 percent of the mapped areas.

Permeability of these soils is rapid, and available water capacity is low. Runoff is slow or medium. The organic-matter content is low, and the natural fertility level is low.

Almost all the acreage of this unit is native rangeland. The soils are not suited to cultivation; they are too steep and erodible. They have poor to fair potential for pasture and range and fair potential for rangeland wildlife habitat. They have very poor potential for all cultivation and for windbreak plantings and poor potential for openland habitat and most recreational and engineering uses.

This unit is best suited to grasses for range. These soils are droughty and severe soil blowing and water erosion are hazards. A cover of grass is effective in controlling soil blowing and water erosion. Overgrazing, however, reduces the protective cover, thus deteriorating the potential native plant community and resulting in severe gullying in the steep areas. Proper use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

Generally these soils are too droughty, too sandy, and too steep to provide good sites for tree plantings. Some areas can be used for recreation, wildlife, and forestation plantings if trees are hand planted and tolerant species are selected.

The soils in this unit have severe limitations for dwellings and local roads and streets because of excessive slopes. Excavation or fill is needed to provide suitable sites for buildings without basements. Dwellings with basements can be designed to complement slope, or slope can be modified by grading. In building roads or streets, possible cuts and fills or designs that complement slope should be considered. Shallow excavations have severe limitations because cutbanks can cave. Protection should be provided and cutbanks sloped to provide stability. Septic tank absorption fields should not be constructed on slopes of more than 15 percent. In less sloping areas drain trenches can be installed on the contour so that effluent is dispersed throughout the absorption field. Seepage and slope are severe limitations for sewage lagoons. Alternate sites where conditions are more favorable should be found. The soils in this unit have severe limitations for recreational uses because they are too steep and too sandy. Alternate sites should be selected.

Capability unit VIs-4 dryland; Simeon soil in Shallow to Gravel range site, Valentine soil in Sands range site; windbreak suitability group 10.

VaE—Valentine fine sand, rolling. This deep, strongly sloping to moderately steep, excessively drained soil is on rolling to hilly sandy uplands. Slopes are complex and range from 6 to 17 percent. Areas range from 20 to 1,000 acres.

Typically the surface layer is dark grayish brown, very friable fine sand about 5 inches thick. The transitional layer is brown, very friable fine sand about 6 inches thick. The underlying material is pale brown, loose fine sand to a depth of 60 inches. In a few areas the surface layer is less than 2 inches thick and slopes are very steep. In some places the surface texture is loamy fine sand.

Included with this soil in mapping are small areas of Dunday and Simeon soils. Dunday soils are less sloping and are lower on the landscape than this Valentine soil. Simeon soils occupy nearly level to gently sloping areas between sand dunes and the upper slopes of steep breaks along drainageways. Included soils make up 5 to 15 percent of the mapped areas.

This soil has rapid permeability. Runoff is slow or medium. The available water capacity is low. The organic-matter content is low, and the natural fertility level is low. The soil absorbs moisture rapidly and releases it readily to plants.

Almost all the acreage is native rangeland. A few small areas, generally those near less sloping soils, are in cultivated crops.

This soil has fair potential for rangeland. It has fair potential for trees, tame pasture, and openland and rangeland wildlife habitat. Potential for recreational facilities and most engineering uses is poor to fair. Potential is very poor for dryland and irrigated crops.

This soil is suited to range, which is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is not suitable for cultivated crops. Those areas that are now cultivated can be seeded to warm season native grasses. In establishing range seedings, practices such as proper seedbed preparation, use of cover crops and adapted seed, and adequate weed control are needed. Areas of range that have been overgrazed are now subject to soil blowing. Small blowouts can be shaped and fenced to exclude livestock. These areas can then be converted to range by reseeding and mulching.

This soil generally is not suited to field windbreaks, but it provides a fair site for farmstead, feedlot, and range or livestock plantings. The soil is so loose that trees should be planted in shallow furrows and not cultivated. Young seedlings may suffer from sand blasting or may be covered by drifting sand during high winds.

This soil has moderate limitations for dwellings, local roads and streets, and septic tank absorption fields because of excessive slope. Excavation or fill to provide suitable sites is needed for dwellings without basements. Dwellings with basements can be designed to complement slope, or slope can be modified by grading. In building local roads and streets, possible cuts and fills or designs that complement slope should be considered. Septic tank filter fields should have drain trenches installed on the contour so that effluent can be dispersed throughout the absorption field. Seepage and slope are severe limitations for sewage lagoons. Alternate sites should be selected. This soil has moderate limitations for campgrounds and picnic areas. It has severe limitations for playgrounds and trails because it is too sandy and there is a danger of soil blowing. Alternate sites should be selected.

Capability unit VIe-5 dryland; Sands range site; windbreak suitability group 7.

VbB—Valentine loamy sand, 0 to 3 percent slopes. This nearly level to very gently sloping soil occurs on uplands in smooth to gently undulating areas around the edges of sand dunes. It is deep and excessively drained. Areas range from 15 to 150 acres.

Typically the surface layer is dark grayish brown, very friable loamy sand about 6 inches thick. The transitional layer is brown, very friable loamy sand about 6 inches thick. The underlying material is pale brown loose fine sand to a depth of 60 inches. In a few areas the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Brocksburg, Dunday, and Simeon soils. Brocksburg soils have a finer textured subsoil and coarse underlying material. They are nearly level and are lower on the landscape than this Valentine soil. Dunday soils are in smoother, slightly lower areas. Simeon soils occupy nearly level to gently sloping areas and are slightly lower than the Valentine soil. Included soils make up about 10 percent of the total acreage.

This soil has rapid permeability. Runoff is slow. The available water capacity is low. The organic-matter content is low, and the natural fertility level is low. The soil absorbs moisture rapidly and releases it readily to plants.

Most of the acreage is native rangeland. A few acres are in cultivated crops, most of which are irrigated.

This soil has poor potential for dryland cultivated crops. It has fair potential for irrigated crops, trees in windbreaks, openland and rangeland wildlife habitat, and most recreational and engineering uses. It has fair potential for pasture and range.

Soil blowing is a severe hazard if this soil is overgrazed or cultivated. Rangeland use is highly effective in controlling soil blowing. Overgrazing or improper haying methods, however, reduce the protective cover, thus deteriorating the potential native plant community and resulting in soil blowing, severe soil losses, and blowouts. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition. Areas in small blowouts that are now subject to soil blowing can be fenced to exclude livestock and then converted to range by reseeding and mulching.

This soil is marginal for dryland row crops. Such close-growing crops as alfalfa, grass, and small grain are better suited. Soil blowing is a moderate to severe hazard in cultivated areas. Low fertility and the somewhat droughty underlying material are moderate limitations. The soil is commonly too loose to be easy to work. Where row crops are planted, narrow strips or fields can be alternated with close-sown crops. A conservation cropping system, which leaves crop residue on the surface, reduces the risk of soil blowing and conserves moisture. Narrow plantings of trees in windbreaks also help to reduce the risk of soil blowing.

Only sprinklers are suitable for irrigating this soil. Center-pivot sprinklers are particularly well suited. Maintaining a large amount of crop residue on the surface in winter and after tillage and planting helps to control soil blowing and maintain fertility. Under irrigation this soil is suited to alfalfa, pasture grasses, close growing crops, corn, and grain sorghum.

This soil generally provides only fair tree planting sites. Capability for survival and growth of adapted species is fair. The soil is so loose that the trees should be planted in shallow furrows and not cultivated. Young seedlings may suffer from sand blasting during high winds and can be covered by drifting sand.

This soil has good suitability as a site for dwellings, septic tank absorption fields, and local roads and streets. Seepage is a problem for sewage lagoons unless the bottom is sealed by special treatment. Limitations are moderate for camp areas, picnic areas, playgrounds, and trails because the soil is too sandy and is subject to blowing.

Capability unit IVe-5 dryland, IVe-11 irrigated; Sandy range site; windbreak suitability group 7.

Ve—Verdel silty clay, 0 to 2 percent slopes. This nearly level, well drained soil formed in clayey alluvium on terraces. It generally occupies the terrace position farthest from the stream channel adjacent to the surrounding clay hills. Individual areas are generally irregular in shape and range from 5 to 60 acres.

The surface layer is dark grayish brown, friable silty clay 14 inches thick. The subsoil is about 26 inches thick. The upper part is dark grayish brown friable silty clay, and the lower part is grayish brown firm silty clay. The underlying material is grayish brown silty clay to a depth of more than 60 inches. Free lime accumulations occur below 28 inches in most places. In some areas the surface layer is silty clay loam. In small areas at the ends of drains and in alluvial fans is a soil that has a lighter colored surface layer and is clayey throughout.

Included with this soil in mapping are small areas of Promise and Hall soils. The Promise soils are gently sloping and slightly higher on the landscape than this Verdel soil. The Hall soils are slightly lower on the landscape. These included areas make up 5 to 15 percent of each mapped area.

Permeability is slow, and surface runoff is slow. The available water capacity is moderate. The shrink-swell potential is high. The organic-matter content is moderate, and the natural fertility level is medium. Reaction is mildly alkaline in the upper layer and moderately alkaline in the lower layers. The surface layer is friable and has good structure if it is well managed, but it puddles readily if worked or trampled when wet. Because of the fine textures, this soil releases water slowly to plants and is somewhat droughty.

Almost all the acreage is cultivated. A few small narrow areas near drainageways are in native range.

The soil has fair to good potential for cultivated crops and fair potential for hay and pasture grasses. Potential is poor for trees in windbreaks. It is good for openland wildlife habitat and fair for rangeland wildlife habitat. Potential is poor for most engineering uses and for recreational facilities.

This soil is suited to dryland small grain, grain sorghum, corn and alfalfa. Small grain is best because it matures before the hot, dry weather begins. Grain sorghum is better suited than corn. Conserving soil moisture, increasing the supply of organic matter, and maintaining good tilth and a high level of fertility are the main management needs in cultivated areas. A conservation tillage system, which keeps residue on the surface, increases absorption of moisture and decreases evaporation. Soil blowing and water erosion are slight hazards on this soil.

In irrigated areas, this soil is suited to corn, grain sorghum, and alfalfa. It is also suited to small grain and grasses. The slow intake of water makes long periods of irrigation necessary. The rate of water application should be adjusted to correspond to the water intake rate of the soil. Land leveling to produce smooth fields and diversions to remove excess run-in water help to reduce flooding from surrounding higher land. Furrow and border irrigation are suited to this soil. Center pivot sprinklers are not well suited because transpiration and evaporation can exceed the intake rate of the soil.

The use of this soil for pasture and legumes is effective in maintaining fertility and good tilth and in controlling erosion. Proper stocking rates, deferred and rotation grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is only fairly well suited to trees. Because it is high in clay, it is somewhat droughty for newly planted seedlings. Moisture competition from grasses and weeds is the principal hazard. Proper site preparation and timely cultivation increase seedling survival. Selection of drought resistant trees and shrubs is also needed.

This soil has severe limitations for dwellings and local roads and streets. The soil expands on wetting and shrinks on drying, which can cause damage to roads and dwelling foundations. It has inadequate strength to support loads. Foundations and footings should be properly designed and artificial drainage established to prevent structural damage. For roads, proper grading and hauling in suitable base material are needed. Limitations for septic tanks are severe because of the slow percolation rate. Increasing the size of the absorption area or using sewage lagoons are ways to overcome this problem.

Capability unit IIs-2 dryland; IIs-1 irrigated; Clayey range site; windbreak suitability group 9.

WeC—Wewela fine sandy loam, 2 to 6 percent slopes. This gently sloping, well drained soil is on uplands where clayey shales are covered with loamy material. Individual areas range from 10 to 150 acres.

Typically the surface layer is dark grayish brown, friable fine sandy loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is brown, firm sandy clay loam, and the lower part is light olive brown,

very firm clay. The underlying material is shaly clay to a depth of 60 inches. In some small areas the surface layer is coarser textured than is typical. In some areas the clay shale and bedded shale are deeper in the profile, and in others the clay shale is at a depth of less than 14 inches.

Included with this soil in mapping are small areas of Dunday, Labu, Ord, Simeon, and Valentine soils. Dunday, Simeon, and Valentine soils are slightly higher on the landscape than this Wewela soil. Labu soils are lower on the landscape. Ord soils are in slightly depressed areas. These included soils make up 10 to 15 percent of the mapped acreage.

Permeability of this soil is moderate in the upper 15 inches and very slow below. The available water capacity is low. Runoff is slow in the less sloping areas and medium in the more sloping areas. The shrink-swell potential is low in the loamy surface layer, moderate in the silty and clayey subsoil, and high in the clayey shale underlying material. The organic-matter content is moderately low, and the natural fertility level is low. This soil is easily tilled because of the loamy surface layer. It takes in water easily, but because of the silty and clayey subsoil and clayey shale underlying material, it releases water slowly to plants. Ponding is common in depressed areas after heavy rains.

About 75 percent of the acreage is in cultivated crops. The rest is mainly in native grass.

This soil has fair potential for pasture and range. It has good potential for openland and rangeland wildlife habitat. It has fair potential for dryland and irrigated crops. It has poor potential for windbreaks. Potential is good to fair for recreational development and poor for most engineering uses.

This soil is suited to most of the dryland crops commonly grown in the county. Grain sorghum, alfalfa, and tame grasses are the main crops. Soil blowing and water erosion are the main hazards. Gully erosion is a hazard in waterways. In areas where shale crops out at or near the surface, cultivation is difficult. Terraces, contour farming, stripcropping, and grassed waterways help to control water erosion. Tillage should be kept to a minimum. A cropping system that includes legumes or a mixture of grasses and legumes helps to replenish the supply of organic-matter, maintain fertility, and control soil blowing. A conservation tillage system, which leaves most of the crop residue on the surface, also helps to conserve moisture and control soil blowing.

This soil is not well suited to irrigation because of unfavorable soil characteristics. The clayey subsoil and the shaly underlying material result in slow water intake rate and very slow permeability.

The use of this soil as range is highly effective in controlling soil blowing and water erosion. Overgrazing or improper haying methods, however, reduce the protective cover and deteriorate the potential plant community. Proper use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range and keep the soil in good condition.

This soil is not suited to field windbreaks, but it provides fair sites for farmstead and feedlot windbreaks, livestock protection windbreaks, and plantings in wildlife and recreation areas. Growth of trees and shrubs is poor because of the high clay content of the subsoil and underlying material. Species selected should be limited to those that are extremely drought tolerant.

This soil has severe limitations for dwellings and local roads and streets. The main problems are the high shrink-swell potential and low bearing strength of the subsoil. Foundations and footings for dwellings and buildings should be properly designed to prevent structural damage from shrinking and swelling. It may be possible to replace the abutting soil material with the readily available material of low clay content. For roads, replacement and modification of the road base should be considered. Because of the high clay content, shallow excavations should be dug when the soil is not wet. Limitations are severe for all onsite sanitary facilities. Because of the depth to rock and the very slow percolation rate, septic tank absorption fields and sewage lagoons are difficult to install. Alternate sites should be selected.

Capability unit IIIe-3 dryland, IIIe-14 irrigated; Sandy range site; windbreak suitability group 9.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and windbreaks, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

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The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

According to the conservation needs inventory of 1967, 43 percent of the agricultural land in Boyd County is used as cropland and 47 percent as rangeland or pastureland. The largest acreage is in corn and sorghum. These crops are followed by alfalfa. Less than 3 percent of the acreage is in wheat.

Based on this soil survey, the potential is good for increased production of food. About 188,900 acres could be developed as cropland. Of this total, 51,690 acres could be irrigated, depending on an adequate and available water supply. An additional 3,600 acres could be developed for irrigation if water could be made available and the erosion hazard controlled.

Dryland management

Water erosion is a major problem on about 67 percent of the cropland. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Second, the sediment produced from erosion pollutes streams. Loss of the surface layer is especially damaging on soils with a clay subsoil, the Labu soil, for example. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, tillage and preparation of a good seedbed are difficult on clay or hardpan spots because the original friable surface layer or subsoil has been eroded away. Such spots are common in areas of the severely eroded Labu soil. The overall hazards of erosion can be reduced if only the more productive soils are used for row crops and the steeper, more erodible soils are used for close growing crops, such as wheat, rye, and alfalfa, or for hay and pasture. Proper use alone can reduce the potential for erosion in many areas.

The kind and the amount of fertilizer to be applied should be based on the results of soil tests and on the content of the moisture in the soil at the time of application. When the subsoil is dry and rainfall is low, the rate at which fertilizer is applied should be slightly lower than the rate needed when the soil is moist. For nonlegume crops, nitrogen fertilizer is beneficial on all soils. Phosphorus and zinc are needed on the more eroded soils and in cut areas after construction of terraces or waterways. On livestock farms, grasses and legumes in the crop rotation as well as the use of manure to improve fertility can reduce erosion on sloping land and also provide nitrogen and improve soil tilth on soils that have short and irregular slopes where contouring and terracing are not practical.

Erosion control can provide a protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps a plant cover on the soil for extended periods can reduce the risk of erosion and can therefore help in maintaining the productive capacity of the soil.

Conservation tillage, which leaves crop residue on the surface after planting, reduces runoff and the risk of erosion. A minimum of 1,000 pounds of row crop residue is needed for maximum protection. Tillage on the contour is effective.

No tillage or a till-plant system of row crop production, both of which are most effective in reducing erosion on sloping land, can be adapted to most soils in the survey area. Terraces and diversions, which reduce the length of slope and thus reduce runoff and the erosion hazard, are most practical on deep, well drained soils that have regular slopes. Nora and Paka soils, for example, are suitable for terracing and contour farming. Contour farming or contour stripcropping are erosion control practices that can be used in Boyd County. They are best adapted to soils with smooth uniform slopes.

Soil blowing is a major hazard on the sandy soils in Boyd County. Blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface cover. Maintaining a plant cover, a surface mulch, or a rough surface through proper tillage can minimize the hazard of soil blowing. Windbreaks of suitable shrubs or trees are effective in reducing wind erosion on the sands or sandy loams. Information on the design of erosion control measures for each kind of soil is contained in the Technical Guide available in local offices of the Soil Conservation Service.

Drainage and soil conditions are minor management problems in Boyd County. Wetness is a problem on less than 10,000 acres of cropland.

Irrigation management

Only 1 to 2 percent of all cropland in Boyd County is irrigated. Irrigation is dominantly by sprinklers. Corn is the chief crop. The same conservation practices that control water erosion and prevent erosion on dryland cropland can also be used on irrigated acreages. Terraces, contour farming, crop residue use, and tillage that leaves a protective cover of crop residue on the surface after planting row crops improve the water intake of the soil, reduce runoff and the risk of erosion, and improve soil tilth.

Sprinkler irrigation can be used on the more sloping soils if conservation practices are applied to control soil erosion. Surface irrigation is more suitable on the more gently sloping soils. Land leveling can increase the efficiency of surface irrigation because an even distribution of water can be obtained. The efficiency of prior irrigation systems can be improved by providing for the recovery of tailwater.

Contour bench leveling or contour furrow irrigation can be used in areas where the slope is 2 to 6 percent. Maximum efficiency is obtained if irrigation is started when about half of the stored water has been used by the plants. Thus, if a soil holds 8 inches of water available to plants, irrigation should be started when about 4 inches has been removed. Irrigation should be planned to replace the amount of water used by the crop.

Management should control or regulate the application of irrigation water in such a way that good crop growth is obtained without wasting soil or water. Furrow irrigation or surface irrigation is most efficient if maximum stream size is used down each row and a tailwater recovery system is used to catch and reuse the water. Sprinkler irrigation is most efficient on the sandier soils, in undulating areas, and where the top foot of soil is kept moist. Center pivot or sprinkler type irrigation systems are effective in applying small amounts of water at frequent intervals.

Irrigated soils generally produce higher yields than dryland soils. Consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed in the harvest of crops. Returning all crop residue and adding barnyard manure and commercial fertilizer help to supply the needed plant nutrients. Soils disturbed during land leveling, particularly if the topsoil has been removed, respond to phosphorus and zinc, as well as to nitrogen. The kinds and amount of fertilizer needed for specific crops should be determined by soil tests.

Pasture and hayland management

All areas in hay or tame pasture should be managed for maximum production. Once the pasture is established, the grasses should remain productive. Rotation grazing, which can meet the needs of the plants and promote uniform utilization of forage, is important if high returns are expected. Many forages are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture can thus provide a balanced ration during the growing season. Irrigated pasture requires a higher level of management for maximum production than is needed on dryland pasture.

If well managed, a mixture of grasses and legumes can be grown on many kinds of soils and return a fair profit. Grasses and legumes can be included with grain crops in a crop rotation and have beneficial soil building effects. They improve soil tilth, add organic matter, and reduce the erosion hazard.

Soil tilth is an important factor in germination of seeds and in the infiltration of the water in the soil. Soils with good tilth are granular and porous.

Pasture and hay, both dryland and irrigated, require additional plant nutrients if maximum production is to be obtained. The kinds and amount of fertilizer needed for the grasses grown should be determined by a soil test.

All soils in Nebraska have been assigned to an irrigation design group. These design groups are described in the Nebraska Irrigation Guide, which is part of the Technical Guide for Conservation in Nebraska. Arabic numbers in the irrigation capability unit indicate the irrigation design group to which the soil belongs.

Assistance in planning and designing an irrigation system is available at the local office of the Soil Conservation Service. Estimates concerning cost of equipment can be obtained from local dealers and manufacturers of irrigation equipment.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 4.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is indicated in table 5. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture may be in low-intensity use, for example, soils in capability classes I and II. Data in this table can be used to determine the farming potential of such soils.

The capability unit is identified in the description of each soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe-4 or IIIe-3.

Rangeland

Prepared by PETER N. JENSEN, range conservationist, Soil Conservation Service.

Scattered rangeland amounts to approximately 42 percent of the total agricultural land in Boyd County. About 70 percent of the rangeland is on the clayey, silty, and limy upland range sites. These sites are the strongly sloping to very steep soils along the Missouri River, Niobrara River, and Ponca Creek tributaries. About 12 percent of the rangeland is on the Sands and Sandy range sites, of which the largest acreage is between the Keya Paha and Niobrara Rivers. The rest is on the bottom lands, the lowland, the overflow, and the shallow sites. The average size of the ranches and livestock farms is about 640 acres.

The raising of livestock, mainly cow and calf herds, is one of the largest agricultural industries in the county. The calves are sold in the fall as feeders. The rangeland is generally grazed from late in spring to early in fall, and the grain sorghum or corn aftermath is grazed in fall and early in winter. The cattle are fed hay, native or alfalfa, silage or both the rest of the winter. The native forage is commonly supplemented with protein.

In some areas of the county the rangeland has been depleted by overuse. The overused pastures are supporting lower forage producing grasses and weeds. Productivity of the range can be increased by using sound range management practices, namely, proper grazing use, timely rests, and planned grazing systems.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 6 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 6.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and environmental plantings

Prepared by JAMES W. CARR, JR., forester, Soil Conservation Service.

Native woodland in Boyd County is limited to narrow strips along the bluffs and on bottom lands of the Missouri River, the Niobrara River, the Keya Paha River, Ponca Creek, and their principal tributaries. Many sites are capable of producing commercial quantities of wood, but their value for esthetics, recreation, wildlife habitat, and watershed protection is even greater.

Eastern cottonwood, American elm, green ash, boxelder, willow, dogwood, and other trees and shrubs that tolerate wetness grow on the nearly level bottom lands. Trees in these areas have a greater growth potential than those on the steeper uplands but much less commercial value.

On the steeper soils, the native woodland is burr oak, American elm, green ash, hackberry, and eastern redcedar and an understory of smooth sumac and coralberry.

Early settlers in Boyd County planted trees for protection, shade, and fence posts. Throughout the years, landowners have continued to plant trees to protect their cropland, buildings, and livestock. Native trees and shrubs can contribute a great deal to the natural beauty of the landscape. In addition, they provide food and cover for wildlife.

The conifers, cedar and pine, are more suitable for windbreaks than other species. They hold their leaves throughout the winter, thus giving maximum protection when it is most needed. Measurements show that these species rate high in survival and vigor. Several species of broad-leaf trees and shrubs that are well suited for use in windbreaks in Boyd County are listed in table 7.

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 7 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 7, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursey.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 8 shows, for each kind of soil, the degree and kind of limitations for building site development; table 9, for sanitary facilities; and table 11, for water management. Table 10 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 8. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, and open ditches. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good, fair*, or *poor*, which, respectively, mean about the same as the terms *slight, moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 9 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as

moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor.*

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 11 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

Prepared by ROBERT O. KOERNER, biologist, Soil Conservation Service.

Recreation in Boyd County is limited mainly to hunting and fishing. The seasons for each are approved and regulated by the Nebraska Game and Parks Commission.

Additional opportunities for recreation are provided at the Spencer Dam Special Use Area, which offers good fishing and hiking, and the Hull Lake Special Use Area, which consists of a 6-acre lake and 34 acres of land south of Butte. The Hull Lake Area offers opportunities for warm water fishing, picnicking, camping, hiking, and non-

power boating. Waterfowl and some big game are available for hunters.

Good areas for hunting also occur along the Missouri River, the Niobrara River, the Keya Paha River, and Ponca Creek. Hunting of big game, such as deer and turkey, during regular seasons is enjoyed by those sportsmen who obtain a permit and hunting access to the land. Hunting of waterfowl is also an important sporting activity during the regular seasons.

Technical assistance is available for designing installations to improve habitat for wildlife as well as facilities for recreation within Boyd County. The Soil Conservation Service field office in Butte can either provide this assistance or direct you to an appropriate agency that can provide the needed assistance.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 12 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 8.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

Prepared by ROBERT O. KOERNER, biologist, Soil Conservation Service.

Habitat on the eleven soil associations in Boyd County is described in the following paragraphs.

The Onita-Reliance-Ree association and the Nora-Crofton-Eltree association consist of silty soils on uplands. Both support openland wildlife species, such as pheasant and bobwhite quail. Scattered trees occur along many fence lines, and shelterbelts are near many farmsteads. Both dryland and irrigated crops provide summer food and cover for many species of wildlife. Undisturbed nesting cover is the limiting factor to increasing the populations of pheasant and quail. Including such crops as alfalfa in the cropping sequence provides pheasants with more nesting cover. The alfalfa should not be mowed until after the pheasants have nested. Nesting occurs usually before July 15.

The Labu-Sansarc association, the Bristow-Lynch association, and the Anselmo-Dunday-Blendon association provide habitat for many species of rangeland wildlife. Prairie grouse, meadowlark, and deer are common. There are also a few antelope. Proper grazing use on the grasslands can benefit the wildlife by providing nesting cover for birds and food for the larger species. The intermittent drainageways have brushy thickets of plum and chokecherry. Hackberry, green ash, burr oak, and redcedar trees are also common. These long narrow areas make good travel lanes for deer and other species of wildlife.

The Dunday-Valentine-Simeon association, the Valentine-Simeon association, and the Meadin-Jansen-O'Neill association harbor many species of rangeland wildlife. Most important are prairie grouse, meadowlark, deer, and

a few antelope. Habitat improvement in these areas includes proper grazing use and development of watering facilities. Some parts of the Dunday-Valentine-Simeon association have been converted from rangeland to irrigated cropland. This change is providing additional food and cover for wildlife.

The Brocksburg-Jansen association is mainly cultivated cropland. The soils are droughty, however, and good crops are not always certain. Values for wildlife habitat, therefore, depend on natural rainfall. This association has few trees, except where windbreaks have been planted near farmsteads. Species of openland wildlife, such as pheasant and bobwhite quail, occur in limited numbers. Lack of sufficient water is the limiting factor for production of both plants and wildlife.

The Inavale-Grigston-Cass assocation (fig. 14) and the Haynie-Albaton-Onawa association are on nearly level bottom land along the main streams of the county, including the Missouri River, the Keya Paha River, and Ponca Creek. These associations offer excellent potential for improving wildlife habitat. The heavily wooded areas along the streams, the brushy draws, and the fields of cultivated crops provide closely associated areas with access to food, cover, and lanes of travel. Nearly all kinds of wildlife common in Boyd County are in these valleys. Mule deer, whitetail deer, wild turkey, pheasant, bobwhite quail, eastern red squirrel, and cottontail rabbit inhabit these areas. Predators, such as hawks, owls, coyote, and raccoon, and many song birds are common. The mourning dove also occurs throughout the country but generally is near areas of water.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, smooth brome, orchardgrass, sweetclover, red clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, switchgrass, wheatgrass, and grama.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are elm, oak, cottonwood, ash, hackberry, willow, and dogwood. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, autumn-olive, honeysuckle, and cotoneaster.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capaci-

ty, and wetness. Examples of native coniferous plants are ponderosa pine and eastern redcedar. Examples of coniferous plants that are commercially available and suited to soils of Boyd County are spruce and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are silver buffaloberry, plum, chokecherry, snowberry, coralberry, and skunkbush sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wheatgrass, saltgrass, and prairie cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, red fox, raccoon, deer, and oppossum.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, white-tailed deer, mule deer, sharptail grouse, meadowlark, and prairie chicken.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 17. The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 17.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by the State of Nebraska Department of Roads.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The codes for shrinkage and Unified classification are those assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-73); Unified classification (D-2487-69) (1975); mechanical analysis (T88-76I); liquid limit (T89-76I); and plasticity index (T90-70). The group index number that is a part of the AASHTO classification is computed using the Nebraska Modified system.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*7*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 18, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisols.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustolls (*Ust*, meaning dry, plus *oll*, from Mollisols).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplustolls (*Hapl*, meaning simple horizons, plus *Ustolls*, the suborder of Mollisols that have a Ustic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, tem-

perature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is coarse-loamy, mixed, mesic, Typic Haplustolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*6*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Albaton series

The Albaton series consists of deep, poorly drained, very slowly permeable soils on nearly level bottom lands of the Missouri River Valley. These soils formed in recent, calcareous clayey alluvium more than 40 inches thick. They are occasionally flooded when water runs in from adjoining land and ponds on the surface. The slope is 0 to 2 percent.

Albaton soils are adjacent to Blake, Haynie, and Onawa soils. Blake and Haynie soils are not so clayey in the Ap and C1 horizons as Albaton soils. They occupy higher positions and are slightly better drained. Onawa soils have thinner clayey deposits and have a coarser textured IIC horizon. They are intermediate in position to Albaton and Blake and Haynie soils.

Typical pedon of Albaton silty clay, 0 to 2 percent slopes, 1,520 feet east and 1,600 feet north of southwest corner sec. 20, T. 34 N., R. 9 W.

Ap—0 to 7 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak medium and fine angular and subangular blocky structure; hard, firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1g—7 to 27 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; common fine distinct reddish brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; strong medium and fine blocky structure; very hard, firm; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2g—27 to 54 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist, and thin strata less than 6 inches thick of light grayish brown (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; few fine distinct strong brown (7.5YR 5/6) and reddish brown (7.5YR 5/6) mottles; mottles are more common in the less clayey stratum of this horizon; strong, medium and coarse blocky structure parting to strong medium and fine angular blocky; horizontal cleavage planes from platy structure between strata of clayey and silty material; very hard, firm; strong effervescence in clayey layers, violent effervescence in silty layers; moderately alkaline; abrupt smooth boundary.

C3g—54 to 60 inches; light gray (2.5Y 7/2) silt loam; grayish brown (2.5Y 5/2) moist; common distinct strong brown (7.5YR 5/6) mottles; horizontal cleavage planes; slightly hard, friable; violet effervescence; moderately alkaline.

The thickness of the solum ranges from 7 to 10 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2. It typically is silty clay but ranges from silty clay loam to clay.

The Cg horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2. This horizon is stratified. It is predominantly silty clay or clay and thin strata of silt loam or silty clay loam. Mottles range from few to common in most or all horizons below the surface horizon. Silty layers generally have the highest concentration of mottles. In some profiles silty and sandy materials occur below 54 inches.

Anselmo series

The Anselmo series consists of deep, well drained, moderately rapidly permeable soils. These soils formed in sandy or loamy eolian sediments on uplands and stream terraces. The slope ranges from 2 to 20 percent.

Anselmo soils are adjacent to Dunday, Mariaville, Labu, Paka, Ree, Reliance, and Simeon soils. Dunday and Simeon soils have more sand in the control section and are on a similar landscape. Mariaville and Paka soils developed in material weathered from siltstone, and Labu soil in material weathered from shale. These soils are below Anselmo on the landscape. Ree and Reliance soils formed in silty material and have an argillic horizon. They are above the Anselmo soils on the landscape.

Typical pedon of Anselmo fine sandy loam, 2 to 6 percent slopes, 300 feet east and 25 feet south of northwest corner sec. 33, T. 34 N., R. 13 E.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; common fine roots; neutral; abrupt smooth boundary.

A12—5 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

B2—16 to 21 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; slightly hard, friable; few fine roots; neutral; gradual smooth boundary.

C1—21 to 34 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

C2—34 to 48 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak fine granular structure; loose; mildly alkaline; gradual smooth boundary.

C3—48 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 11 to 32 inches. The thickness of the mollic epipedon ranges from 7 to 18 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It dominantly is fine sandy loam but ranges to loam and loamy fine sand. It is neutral or slightly acid.

The B2 horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 through 4. It is fine sandy loam or loam. It is neutral or mildly alkaline.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. The lower part is sandy loam, loamy fine sand, and fine sand. Texture commonly becomes coarser with depth. In some pedons the C horizon is stratified. Silty and loamy strata below 40 inches are common. Reaction is mildly alkaline or moderately alkaline.

Barney series

The Barney series consists of poorly drained soils on flood plains of major stream valleys. These soils are frequently flooded. They formed in this loamy material over sand and gravel. Permeability is moderately rapid in the loamy surface material and very rapid in the underlying sand and gravel. The slope is 0 to 2 percent.

Barney soils are commonly adjacent to Inavale, Grigston, Leshara, and Ord soils and Riverwash. Inavale and Grigston soils are deep and well drained and occur at higher elevations. Leshara and Ord soils are somewhat poorly drained and occur at slightly higher elevations. Riverwash does not have the loamy texture of Barney soils and is very poorly drained. It occupies the lowest levels adjacent to the stream channels.

Typical pedon of Barney silt loam, 0 to 2 percent slopes, 3,600 feet south and 1,000 feet east of northwest corner sec. 4, T. 32 N., R. 9 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; parting to weak fine granular; slightly hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

A12—5 to 10 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; few fine faint dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; few thin strata of finer and coarser material; slight effervescence; mildly alkaline; clear wavy boundary.

IIC—10 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; common coarse sand and gravel; slight effervescence; moderately alkaline.

Thickness of the solum ranges from 7 to 10 inches. Mollic colors extend to a depth of 7 to 10 inches. Depth to the sand or mixed sand and gravelly IIC horizon ranges from 7 to 20 inches. Depth to carbonates ranges from 0 to 15 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is stratified. It commonly averages silt loam but ranges to silty clay loam, loam, very fine sandy loam, sandy loam, fine sandy loam, or loamy fine sand.

The C horizon is present in some pedons. It has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3. It is stratified loam, sandy loam, fine sandy loam, loamy sand, or loamy fine sand.

Blake series

The Blake series consists of deep, somewhat poorly drained soils on nearly level bottom lands of the Missouri River Valley. Permeability is moderately slow or moderate in the upper part of the soil and moderate or moderately rapid in the lower part. These soils formed in recently deposited calcareous alluvium. They are subject to occasional flooding by runoff from adjoining lands. Overflow from the Missouri River has been largely eliminated since construction of the dams. The slope is 0 to 2 percent.

Blake soils are commonly adjacent to Albaton, Haynie, and Onawa soils. Albaton soils have a fine textured control section, and Onawa soils have a clayey over loamy control section. Both soils are at slightly lower elevations than Blake soils. Haynie soils are coarse-silty and occur at slightly higher elevations.

Typical pedon of Blake silty clay loam, 0 to 2 percent slopes, 1,000 feet east and 200 feet north of southwest corner sec. 18, T. 34 N., R. 9 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak medium and coarse granular; hard, friable; moderately alkaline; abrupt smooth boundary.

C1—8 to 20 inches; stratified grayish brown (2.5Y 5/2) silty clay loam and thin layers of silty clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; hard, firm; moderately alkaline; clear smooth boundary.

C2—20 to 25 inches; stratified light brownish gray (2.5Y 6/2) silty clay loam and thin layers of silty clay, grayish brown (2.5Y 5/2) moist; few fine distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, firm; moderately alkaline; abrupt wavy boundary.

IIC3—25 to 60 inches; stratified light brownish gray (2.5Y 6/2) very fine sandy loam, coarse silt loam, and silty clay loam layers less than 6 inches thick, grayish brown (2.5Y 5/2) moist; few to common fine distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles that are most prominent just above the finer textured strata; very weak coarse subangular blocky structure; some horizontal cleavage and bedding planes evident in finer textured strata; soft, very friable; moderately alkaline.

The thickness of the solum ranges from 7 to 10 inches. Depth to horizons less clayey than silty clay loam ranges from 18 to 30 inches. Reaction is mildly or moderately alkaline throughout.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2. It is stratified silty clay loam with thin layers of higher clay content. Mottles are few to common and dark brown to strong brown. The IIC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2.

Blendon series

The Blendon series consists of deep, well drained, moderately rapidly over rapidly permeable soils. These soils are on stream terraces and alluvial fans and in upland swales and valleys. They formed in moderately coarse textured alluvial and colluvial materials. The slope is plane to concave and ranges from 0 to 6 percent.

Blendon soils are adjacent to Anselmo, Dunday, Onita, and Paka soils. Anselmo, Dunday, and Paka soils have a mollic epipedon less than 20 inches thick. Dunday soils have less clay in the control section. Paka soils have weathered siltstone within depths of 40 to 60 inches. All these soils are generally higher on the landscape than Blendon soils. Onita soils formed in loess and have a fine textured B horizon. They occur in positions similar to those of Blendon soils.

Typical pedon of Blendon fine sandy loam, 2 to 6 percent slopes, 100 feet north and 50 feet west of southeast corner sec. 6, T. 33 N., R. 12 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common very fine roots; neutral; abrupt smooth boundary.

A12—4 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; slightly hard, very friable; common very fine roots; neutral; clear smooth boundary.

B2—16 to 22 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable; few very fine roots; neutral; clear smooth boundary.

C1—22 to 42 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; soft, very friable; neutral; clear smooth boundary.

C2—42 to 60 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure parting to single grained; loose; neutral.

The thickness of the solum ranges from 24 to 50 inches. The thickness of the mollic epipedon ranges from 22 to 28 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 2. It typically is fine sandy loam or sandy loam but is loam in some pedons.

The B horizon has value of 3 through 5 (2 through 4 moist) and chroma of 2 or 3. It is fine sandy loam or sandy loam.

The C horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 through 4. It is typically loamy sand or loamy fine sand.

Boyd series

The Boyd series consists of moderately deep, well drained, very slowly permeable soils on residual uplands. These soils formed in dark colored clayey shale material. The slope ranges from 6 to 11 percent.

Boyd soils are similar to Labu and Lynch soils and are commonly adjacent to Labu, Promise, and Sansarc soils. Labu and Lynch soils lack a mollic epipedon. Lynch soils formed in lighter colored shales and have higher concentrations of carbonates and sulphates in the B2 horizon. They are lower on the landscape than Boyd soils. Promise soils are deeper over shale. They occur on the lower foot slopes. Sansarc soils, on steep higher landscapes do not have a mollic epipedon. They are less than 20 inches deep over shale.

Typical pedon of Boyd silty clay, 6 to 11 percent slopes, 500 feet east and 100 feet south of center sec. 36, T. 33 N., R. 10 W.

A1—0 to 6 inches; dark gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) moist; medium and fine granular structure; hard, friable; mildly alkaline; gradual smooth boundary.

B1—6 to 10 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse subangular blocky structure parting to weak medium and fine granular structure; hard, friable; slight effervescence; moderately alkaline; clear smooth boundary.

B2—10 to 22 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm; few small lime concretions and many medium carbonate segregations along ped faces; some discontinuous clay skins along ped faces; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—22 to 32 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm; some lime segregations, 1 1/2 inches in diameter by 1/4 inch thick between peds; violent effervescence; moderately alkaline; clear smooth boundary.

Cr—32 to 60 inches; pale olive (5Y 6/3) shaly clay, olive (5Y 4/4) moist; massive; extremely hard, extremely firm; some bedded shale chunks below 32 inches; strong effervescence except on segregated ped faces; moderately alkaline.

The thickness of the solum ranges from 17 to 30 inches. Thickness of the mollic epipedon ranges from 9 to 15 inches. Depth to bedded shale ranges from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2. It has subangular blocky or granular structure.

The B horizon has hue of 2.5Y or 10YR, value of 4 through 6 (3 to 5 moist), and chroma of 2 or 3. Clay content ranges from 50 to 60 percent. Depth to segregated lime ranges from 12 to 18 inches.

The C horizon has hue of 2.5Y or 5Y, value of 4 through 6 (4 or 5 moist), and chroma of 3. The shale in the Cr horizon has hue of 2.5Y or 5Y, value of 4 through 7 dry or moist, and chroma of 2 or 3.

Bristow series

The Bristow series consists of shallow, well drained or excessively drained, slowly permeable soils on residual uplands. These soils formed in light colored, calcareous soft shale. The slope ranges from 6 to 40 percent.

Bristow soils are similar to Sansarc soils and are commonly adjacent to Boyd, Labu, Lynch, and Promise soils. Sansarc soils occur higher in the landscape than Bristow soils. They formed in darker colored shale and contain less calcium carbonates and gypsum. Boyd, Labu, Lynch, and Promise soils occur lower on the landscape and are more than 20 inches deep over bedded shale. In addition Boyd and Promise soils have a mollic epipedon.

Typical pedon of Bristow silty clay, 20 to 40 percent slopes, 600 feet south and 150 feet west of northeast corner sec. 22, T. 33 N., R. 11 W.

A1—0 to 7 inches; pale brown (10YR 6/3) silty clay, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure parting to moderate fine and very fine granular; hard, friable; many very fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

C1—7 to 17 inches; light yellowish brown (2.5Y 6/4) very shaly clay, light olive brown (2.5Y 5/4) moist; massive; more than 60 percent partly weathered platy shale fragments; visible accumulations of calcium carbonates and gypsum in seams and fractures of the shale; many fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—17 to 60 inches; pale yellow (2.5Y 7/4) and yellow (2.5Y 7/6) bedded shale, light olive brown (2.5Y 5/6) moist; fractured shale with visible accumulations of calcium carbonate and gypsum in seams and fractures; few roots entering zones between shale fragments; moderately alkaline.

The thickness of the solum is 5 to 10 inches. Depth to bedded shale typically is 8 to 16 inches but ranges from 5 to 20 inches. Reaction in the solum is mildly or moderately alkaline, and the calcium carbonate equivalent ranges from 15 to 25 percent. The content of carbonate-free clay ranges from 38 to 50 percent in the control section. Colors are largely inherited from the parent shale.

The A horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 to 5 moist), and chroma of 3 or 4. It is dominantly silty clay loam, clay loam, or clay.

The C horizon has hue of 10YR or 2.5Y, value of 6 through 8 (4 through 6 moist), and chroma of 4 through 6. The range in texture is like that of the A horizon. The parent shale is 30 to 40 percent by volume accumulations of gypsum in seams and fractures.

Brocksburg series

The Brocksburg series consists of well drained soils on uplands. These soils formed in loamy and loesslike material over sand and gravel. Permeability is moderate in the subsoil and very rapid in the underlying material. The slope is 0 to 2 percent.

Brocksburg soils are similar to Jansen soils and are commonly adjacent to Meadin and O'Neill soils. Jansen soils have a thinner mollic epipedon and are lower on the landscape. Meadin soils have sand and gravel within a depth of 20 inches. O'Neill soils have less clay in the B horizon.

Typical pedon of Brocksburg loam, 0 to 2 percent slopes, 1,950 feet south and 50 feet east of northwest corner sec. 34, T. 35 N., R. 16 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—6 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

B21t—14 to 22 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few thin clay films on ped faces; neutral; clear smooth boundary.

B22t—22 to 30 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few thin clay films on ped faces; neutral; clear smooth boundary.

C1ca—30 to 34 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; hard, friable; common fine distinct lime segregations; violent effervescence; mildly alkaline; abrupt wavy boundary.

IIC1—34 to 38 inches; grayish brown (10YR 5/2) gravelly coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose; mildly alkaline; gradual smooth boundary.

IIC2—38 to 60 inches; light yellowish brown (10YR 6/4) gravelly sand; yellowish brown (10YR 5/4) moist; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 25 to 34 inches. The depth to sand and gravel ranges from 28 to 38 inches. The mollic epipedon is 20 to 28 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2. It typically is loam but ranges from fine sandy loam to silt loam.

The B21t horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is loam or clay loam. The B22t horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is clay loam or loam.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. Reaction is neutral or mildly alkaline. Texture ranges from clay loam to gravelly loam. The IIC horizon is gravelly sand.

Cass series

The Cass series consists of deep, well drained, moderately rapidly permeable soils formed in mixed sandy and loamy alluvium on bottom lands. These soils are subject to occasional flooding. The slope is 0 to 2 percent.

Cass soils are commonly adjacent to Barney, Grigston, Inavale, Leshara, and Ord soils. Barney soils are poorly drained and are generally at the lowest elevations. Grigston soils are fine-silty. They are similar to Cass soils in depth to water table and location on the landscape. Inavale soils are sandier, do not have a mollic epipedon, and commonly are nearer to stream channels than Cass soils. Leshara and Ord soils are somewhat poorly drained and are at lower elevations.

Typical pedon of Cass fine sandy loam, 0 to 2 percent slopes, 2,500 feet north and 300 feet east of southwest corner sec. 17, T. 34 N., R. 12 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

A12—5 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; soft, very friable; neutral; clear smooth boundary.

AC—12 to 26 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

C1—26 to 38 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; loose; mildly alkaline; gradual smooth boundary.

C2—38 to 60 inches; very pale brown (10YR 7/3) coarse sand, pale brown (10YR 6/3) moist; single grained; loose; mildly alkaline.

The thickness of the mollic epipedon ranges from 11 to 15 inches.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 1 or 2. It typically is fine sandy loam or loam. It is slightly acid or neutral.

The C horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3. It is fine sandy loam or loamy fine sand. Strata of sandier or loamier material are common, and some profiles are fine sand and coarse sand in the lower part. This horizon ranges from slightly acid to mildly alkaline.

Crofton series

The Crofton series consists of deep, calcareous well drained soils on uplands. These soils formed in silty, calcareous loess on convex ridges and hillsides. The slope ranges from 11 to 15 percent.

Crofton soils are commonly adjacent to Eltree, Mariaville, Nora, and Paka soils. Eltree, Nora, and Paka soils have a mollic epipedon and a B horizon. They are deeper over carbonates than Crofton soils. All occupy similar positions but are less sloping than Crofton soils. Mariaville soils are steep and very steep and have soft siltstone within a depth of 20 inches.

Typical pedon of Crofton silt loam, 11 to 15 percent slopes, eroded, 1,800 feet south and 75 feet east of northwest corner sec. 1, T. 33 N., R. 9 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

AC—6 to 14 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, slightly friable; common hard and soft, medium and fine lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—14 to 20 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium and fine subangular blocky structure; slightly hard, friable; common hard and soft, medium and fine lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—20 to 33 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; coarse medium and fine subangular blocky structure; slightly hard, friable; common hard and soft, medium and fine lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C3—33 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; massive; soft, friable; few soft fine lime accumulations; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 14 inches. Depth to free carbonates ranges from 0 to 6 inches.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly silt loam but ranges to light silty clay loam.

The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4.

Dunday series

The Dunday series consists of deep, well drained and excessively drained, moderately rapidly over rapidly permeable soils on uplands and terraces. These soils formed in eolian sands. They occupy mainly enclosed valleys, broad divides, and side slopes of drainageways. The slope ranges from 0 to 11 percent.

Dunday soils are commonly adjacent to Anselmo, Brocksburg, Mariaville, Simeon, and Valentine soils. Anselmo soils have a finer textured control section and are on side slopes below Dunday. Brocksburg soils have an argillic horizon and a coarser textured substratum. Mariaville soils contain more silt. They are shallow over siltstone and are lower on the landscape. Simeon and Valentine soils lack a mollic epipedon and generally occur above Dunday soils.

Typical pedon of Dunday loamy fine sand, 3 to 6 percent slopes, 2,100 feet south and 100 feet east of northwest corner sec. 8, T. 33 N., R. 16 W.

A11—0 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; slightly acid; clear smooth boundary.

A12—10 to 15 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; neutral; gradual smooth boundary.

AC—15 to 22 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to single grained; soft, very friable; neutral; gradual smooth boundary.

C—22 to 60 inches; light brownish gray (10YR 6/2) fine sand, brown (10YR 5/3) moist; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 14 to 30 inches, and thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 dry (2 or 3 moist), and chroma of 2. Reaction is slightly acid or neutral.

The AC horizon has value of 5 through 6 (3 or 4 moist) and chroma of 2 or 3. It is loamy fine sand or loamy sand and is slightly acid or neutral.

The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. In some pedons buried loamy or silty layers are in the lower part of the C horizon.

Eltree series

The Eltree series consists of deep, well drained, moderately permeable soils formed in calcareous loess. These soils are on upland divides. The slope is 0 to 2 percent.

Eltree soils are commonly adjacent to Crofton, Nora, Onita, Ree, and Reliance soils. Crofton soils are on steep side slopes and do not have a mollic epipedon. Nora soils have a mollic epipedon less than 20 inches thick and are in gently sloping to moderately sloping areas. Onita soils have a fine textured argillic horizon. Ree and Reliance soils have an argillic horizon and a mollic epipedon less than 20 inches thick and are generally on steeper side slopes. In addition, Ree soils are underlain with sandier materials.

Typical pedon of Eltree silt loam, 0 to 2 percent slopes, 1,900 feet south and 500 feet east of northwest corner sec. 34, T. 34 N., R. 9 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse granular structure; slightly hard, very friable; mildly alkaline; abrupt smooth boundary.

A12—7 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse blocky structure parting to weak medium granular; slightly hard, friable; mildly alkaline; gradual smooth boundary.

A13—10 to 25 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; many fine hairlike lime accumulations in root channels; strong effervescence on faces of peds; gradual smooth boundary.

B21—25 to 31 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; slightly hard, friable; few fine films and threads of lime accumulations; violent effervescence; mildly alkaline; gradual smooth boundary.

B22—31 to 38 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, friable; few fine soft masses of lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C—38 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, friable; common medium soft masses of lime accumulations; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 44 inches. Depth to free carbonates ranges from 0 to 15 inches. The mollic epipedon is 20 to 32 inches thick. A buried A horizon occurs below 40 inches in some pedons. Films and threads and soft masses of lime accumulations are in the B horizon and upper part of the C horizon.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2. It dominantly is silt loam but ranges to very fine sandy loam and loam. It is neutral or mildly alkaline.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silt loam or very fine sandy loam, averaging between 18 and 25 percent clay and less than 15 percent fine sand or coarser materials. It is mildly or moderately alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is mildly or moderately alkaline.

Grigston series

The Grigston series consists of deep, well drained, moderately permeable soils on bottom lands and low stream terraces. These soils formed in calcareous loamy alluvium. They are subject to occasional or frequent flooding. The slope is 0 to 3 percent.

Grigston soils are commonly adjacent to Barney, Cass, Hall, Inavale, Leshara, Ord, and Verdel soils. Barney, Leshara, and Ord soils have a higher water table than Grigston soils, and occur at lower elevations. Cass soils formed in sandy and loamy material. Inavale soils formed in sandy material. Both occupy positions similar to those of Grigston soils. Hall soils have an argillic horizon and occupy terraces higher on the landscape. Verdel soils are fine textured and also occur in higher terrace positions.

Typical pedon of Grigston silt loam, 0 to 2 percent slopes, 2,000 feet east and 1,500 feet south of center sec. 17, T. 34 N., R. 12 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse blocky structure parting to moderate medium blocky; slightly hard, friable; neutral; clear smooth boundary.

B2—15 to 22 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; hard, friable; slight effervescence; mildly alkaline; gradual smooth boundary.

B22ca—22 to 31 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C1—31 to 54 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; stratified; soft, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—54 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to weak fine subangular blocky; stratified; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 40 inches. Depth to free carbonates ranges from 15 inches to more than 40 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. The underlying material is commonly stratified with sandy, silty, and clayey material.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam and is neutral or mildly alkaline.

The B2 horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 or 3. It is silt loam or silty clay loam and is mildly or moderately alkaline.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3. It is silt loam, loam, or fine sandy loam and is mildly to moderately alkaline.

Hall series

The Hall series consists of deep, well drained, moderately slowly permeable soils on stream terraces. These soils formed in stratified silty alluvium with a component of loess on the surface. The slope is 0 to 2 percent.

Hall soils are commonly adjacent to Blendon, Cass, Grigston, Inavale, Lynch, Promise, and Verdel soils. Blendon and Cass soils have a coarse-loamy control section. Grigston soils do not have an argillic horizon. Inavale soils have a sandy control section and do not have a mollic epipedon. These four soils are at lower elevations and are generally nearer the stream channels. Lynch, Promise, and Verdel soils have a finer textured control section. They occur above Hall soils in the landscape.

Typical pedon of Hall silt loam, 0 to 2 percent slopes, 1,050 feet east and 25 feet south of northwest corner sec. 22, T. 33 N., R. 10 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—5 to 18 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak medium and fine granular; slightly hard, friable; neutral; clear smooth boundary.

B21t—18 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; neutral; clear smooth boundary.

B22t—24 to 36 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; neutral; clear smooth boundary.

B3—36 to 42 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 3/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; clear smooth boundary.

Cca—42 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak coarse and medium prismatic structure; hard, firm; mildly alkaline.

The thickness of the solum ranges from 26 to 44 inches. No free carbonates are in the solum, but carbonates are in the C horizon of many pedons. The mollic epipedon, 20 to 36 inches thick, extends into the upper part of the Bt horizon.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam but ranges to loam and silty clay loam.

The Bt horizon has value of 3 through 6 (3 or 4 moist) and chroma of 1 through 3. It is silty clay loam, averaging between 28 to 35 percent clay.

The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 or 3. It typically is silt loam but ranges to silty clay loam, loam, and fine sandy loam.

Haynie series

The Haynie series consists of deep, moderately well drained, moderately permeable soils on low bottom lands of the Missouri River Valley. These soils formed in recently deposited, calcareous alluvium. They are occasionally flooded. The slope is 0 to 2 percent.

Haynie soils are near Albaton, Blake, Onawa, and Inavale soils. Albaton soils and Onawa soils are finer textured and are at lower elevations. Blake soils are more than 18 percent clay in the control section and have a finer textured surface layer. They are at slightly lower elevations. The more sandy Inavale soils are in similar positions.

Typical pedon of Haynie silt loam, 0 to 2 percent slopes, 1,250 feet north and 50 feet east of southwest corner sec. 17, T. 34 N., R. 9 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure parting to weak fine subangular blocky and fine granular; some slight horizontal cleavage and color stratification; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—7 to 18 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, very friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—18 to 32 inches; light grayish brown (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist, stratified with layers of loamy very fine sand 1/2 to 2 inches thick; some horizontal cleavage planes, evident in the silty layers; very weak coarse and medium subangular blocks and medium platy clods; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C3—32 to 46 inches; light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; few fine distinct mottles; dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; soft, very friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

IIC4—46 to 60 inches; pale brown (10YR 6/3) fine sand, grayish brown (10YR 5/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; single grained; loose; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 7 to 10 inches. Free carbonates are at or near the surface in most pedons.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2. It is coarse silt loam or very fine sandy loam and thin strata of finer textured material. Stains and mottles are few to common throughout the C horizon and are more common at depths below 24 inches. A substratum of fine sand occurs in some pedons at depths of 40 to 60 inches.

Inavale series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on bottom lands and on low ridges along major streams. These soils formed in recent sandy alluvium. Flooding is rare to frequent. The slope ranges from 0 to 11 percent.

Inavale soils are commonly adjacent to Barney, Cass, Grigston, Leshara, and Ord soils. Barney soils are poorly drained and occur on the lowest positions in the landscape. Cass and Grigston soils have a mollic epipedon, have a finer textured control section than Inavale soils, and occupy similar or slightly higher positions on the landscape. Leshara and Ord soils have a mollic epipedon and are somewhat poorly drained. They are also in lower lying positions.

Typical pedon of Inavale loamy fine sand, 0 to 3 percent slopes, 1,320 feet west and 100 feet south of northeast corner sec. 3, T. 32 N., R. 11 W.

A1—0 to 9 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; soft, very friable; mildly alkaline; abrupt wavy boundary.

AC—9 to 19 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; very weak coarse blocky structure parting to single grained; loose; mildly alkaline; clear wavy boundary.

C—19 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grained; loose; mildly alkaline.

The thickness of the solum ranges from 12 to 20 inches. Most profiles are neutral or mildly alkaline in reaction, but some are moderately alkaline.

The A horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2. It typically is loamy fine sand but ranges to fine sand, loamy sand, sandy loam, and fine sandy loam. Reaction is neutral or mildly alkaline.

The AC and C horizons have color value of 5 through 7 (4 to 6 moist) and chroma of 2 or 3. These horizons are loamy fine sand, loamy sand, or fine sand. Reaction ranges from neutral to moderately alkaline.

Jansen series

The Jansen series consists of well drained soils on uplands. Permeability is moderate in the solum and very rapid in the underlying material. The soils formed in loamy material or loess over alluvial sand and gravel. Slopes range from 0 to 11 percent.

Jansen soils are similar to Brocksburg and O'Neill and are commonly adjacent to Brocksburg, Dunday, Meadin, O'Neill, Simeon, and Valentine soils. Brocksburg soils have a mollic epipedon thicker than 20 inches. Dunday and Valentine soils are deep and formed in sandy material. O'Neill soils have a coarse-loamy over sandy or sandy-skeletal control section. Simeon soils are coarser textured above the C horizon. Meadin soils have sand and gravel at a depth of less than 20 inches. O'Neill and Meadin soils are commonly below Jansen soils on the landscape.

Typical pedon of Jansen loam, 2 to 6 percent slopes, 1,600 feet south and 100 feet west of northeast corner sec. 36, T. 35 N., R. 16 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; weak medium and fine granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

A12—5 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium subangular blocky structure; slightly hard, friable; few small scattered pebbles in this horizon; slightly acid; clear smooth boundary.

B1—9 to 13 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate coarse blocky structure parting to moderate medium and fine subangular blocky; hard, firm; slightly acid; clear smooth boundary.

B21t—13 to 21 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; shiny film on faces of peds; slightly acid; clear smooth boundary.

B3—21 to 32 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; hard, firm; slightly acid; clear wavy boundary.

IIC—32 to 60 inches; pale brown (10YR 6/3) gravelly coarse sand, light yellowish brown (10YR 5/3) moist; single grain; loose; neutral.

Thickness of the solum ranges from 20 to 40 inches. Thickness of the mollic epipedon ranges from 9 to 20 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. The texture is loam or silt loam.

The B21t horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 to 4. The texture ranges from loam to clay loam. The B22t horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 3 or 4. It is clay loam or sandy clay loam.

The IIC horizon is stratified sand and gravel.

Labu series

The Labu series consists of moderately deep, well drained, slowly permeable soils on residual uplands. These soils formed in residuum from clay shale (fig. 15). Slopes range from 6 to 30 percent.

Labu soils are similar to Boyd and Lynch soils and are commonly adjacent to Boyd, Bristow, Promise, and Sansarc soils. Boyd and Promise soils have a mollic epipedon. Promise soils are on lower foot slopes, are more than 60 percent clay in the control section, and are deeper than 40 inches over bedded shale. Lynch soils have a higher concentration of carbonates in the B2 horizon than Labu soils and formed in lighter colored shale. They are lower on the landscape than Labu soils. Bristow and Sansarc soils are steeper and are less than 20 inches deep over bedded shale.

Typical pedon of Labu silty clay in an area of Labu-Sansarc silty clays, 11 to 30 percent slopes, 1,520 feet east and 300 feet south of northwest corner sec. 27, T. 35 N., R. 14 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, firm, sticky and very plastic; common fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

B21—6 to 14 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and fine blocky; hard, firm, sticky and very plastic; common fine roots; upper 2 inches contains few shale fragments; strong effervescence; moderately alkaline; clear smooth boundary.

B22—14 to 25 inches; light brownish gray (2.5Y 6/2) silty clay, light olive brown (2.5Y 5/4) moist; weak medium and coarse blocky structure parting to moderate medium and fine subangular blocky; very hard, very firm, very sticky and very plastic; few fine and common very fine roots; common pressure faces; few fine segregations of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C1—25 to 34 inches; light gray (2.5Y 7/2) shaly clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, very sticky and very plastic; few fine roots in upper 3 inches; common pressure faces; few distinct lime accumulations and oxidized iron stains; violent effervescence; moderately alkaline; clear smooth boundary.

Cr—34 to 60 inches; light gray (2.5Y 7/2) bedded shale, grayish brown (2.5Y 5/2) moist; massive breaking to moderate medium and coarse platy fragments; very hard, very firm; violent effervescence; moderately alkaline.

The thickness of the solum is typically 25 inches but ranges from 16 to 30 inches. Depth to bedrock ranges from 20 to 40 inches. The solum averages between 45 and 60 percent clay. It is mildly or moderately alkaline. Cracks 1/2 inch to 1 1/2 inches wide and several feet long commonly extend through the solum when the soil is dry.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It commonly is silty clay but ranges to clay.

The B2 horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is silty clay or clay. Pressure faces are common to many.

The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. The Cr horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4.

Leshara series

The Leshara series consists of deep, somewhat poorly drained, moderately permeable soils on bottom lands of the major streams These soils formed in silty alluvial material. They are occasionally flooded. The slope is 0 to 2 percent. These soils have free carbonates nearer the surface than is defined for the series, but this difference does not alter the use or behavior characteristics of the soil.

Leshara soils are commonly adjacent to Barney, Cass, Grigston, Inavale, and Ord soils and Riverwash. Barney soils are poorly drained and have sand and gravel in the lower part of the control section. They are at lower elevations than Leshara soils, generally nearer the stream channels. Cass, Grigston, and Inavale soils are better drained and occur at the higher elevations. Cass and Inavale soils are coarser textured. Ord soils have a coarse-loamy control section. They occur in positions similar to those of Leshara soils. Riverwash is very poorly drained and occurs lower on the landscape.

Typical pedon of Leshara silt loam, 0 to 2 percent slopes, 1,950 feet east and 350 feet south of northwest corner sec. 12, T. 33 N., R. 12 W.

A11—0 to 10 inches, dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate fine and medium granular structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—10 to 21 inches; gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; many medium and fine distinct yellowish brown (10YR 5/6) mottles; weak medium blocky structure parting to moderate medium and coarse granular; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A13—21 to 29 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak medium and fine subangular blocky; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—29 to 32 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; many fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky; slightly hard, friable; slight effervescence; moderately alkaline; clear smooth boundary.

IIC1—32 to 36 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to weak medium granular; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

IIC2—36 to 60 inches; brown (10YR 5/3) sandy loam, dark yellowish brown (10YR 3/4) moist; few fine faint yellowish brown (10YR 5/4) mottles; weak medium and fine subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 29 inches. Thickness of the mollic epipedon ranges from 10 to 32 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. Some pedons have a lighter colored overwash layer on the surface. This layer is typically silt loam and silty clay loam and fine sandy loam.

The C horizon has color value of 4 through 6 (3 or 4 moist) and chroma of 1 or 2. The texture is silt loam or loam. The IIC horizon has colors like those of the C horizon. It is stratified, and the texture ranges from fine sand to silt loam.

Lynch series

The Lynch series consists of moderately deep, well drained soils on uplands. Permeability is slow. These soils formed in clay residuum from calcareous and gypsiferous, light colored, soft shale (fig. 16). They are in the lower gently sloping or strongly sloping areas where the

Mobridge member of the Pierre Shale Formation is exposed. Slopes range from 2 to 30 percent.

Lynch soils are similar to Boyd and Labu soils and are commonly adjacent to Boyd, Bristow, Labu, Verdel, and Hall soils. Boyd and Labu soils developed from darker shales and have smaller amounts of carbonates and sulphates. Bristow soils have bedded shale within 20 inches of the surface and occur on steeper, higher side slopes. Verdel and Hall soils have a thicker mollic epipedon and occur on terraces lower on the landscape.

Typical pedon of Lynch silty clay, 6 to 11 percent slopes, 2,112 feet north and 200 feet east of southwest corner sec. 14, T. 33 N., R. 11 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; 15 percent calcium carbonates; moderately alkaline; abrupt smooth boundary.

A12—4 to 8 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; hard, firm but crumbly; strong effervescence; approximately 20 percent calcium carbonates; moderately alkaline; abrupt wavy boundary.

B1—8 to 14 inches; light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; weak coarse subangular blocky structure parting to moderate medium and fine angular blocky; hard, firm; strong effervescence; approximately 25 percent calcium carbonates; moderately alkaline; gradual smooth boundary.

B2—14 to 28 inches; light yellowish brown to light olive brown (2.5Y 5/4) silty clay; olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm; strong effervescence; approximately 37 percent calcium carbonates; moderately alkaline; clear smooth boundary.

C1—28 to 36 inches; light yellowish brown (2.5Y 6/4) heavy silty clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm; common lime and gypsum crystals interspersed with clay; strong effervescence; approximately 21 percent calcium carbonates; moderately alkaline; gradual smooth boundary.

Cr—36 to 60 inches; pale yellow (2.5Y 7/4) silty clay and shale fragments, light olive brown (2.5Y 5/4) moist; many lime and gypsum crystals interspersed with clay and shale fragments; massive; hard, firm; strong effervescence; approximately 15 percent calcium carbonates; moderately alkaline.

The thickness of the solum typically is 17 to 35 inches thick, and the depth to soft partly weathered shale is 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 through 6 (2 through 4 moist), and chroma of 2 or 3. Silty clay is the dominant texture, but because of the gypsum, the soil is coarser textured.

The B horizon has color value of 4 through 6 (3 through 5 moist) and chroma of 3 or 4. It is clay or silty clay.

The shale of the C horizon has hue of 2.5Y or 5Y, value of 6 through 8 (4 through 6 moist), and chroma of 3 or 4. Gypsum content ranges from 30 to 40 percent.

Mariaville series

The Mariaville series consists of shallow, well drained soils formed in sediments weathered from soft siltstone. These soils are on upper side slopes bordering deeply entrenched streams and larger streams. Permeability is moderate. Slopes range from 15 to 40 percent.

Mariaville soils are commonly adjacent to Anselmo, Boyd, Dunday, Labu, Meadin, O'Neill, Paka, and Sansarc soils. Anselmo and Dunday soils contain more sand than Mariaville soils. They are deeper, formed in sandy and loamy materials, and generally occur above Mariaville soils. Boyd, Labu, and Sansarc contain more clay. They formed in shale on lower side slopes. Meadin and O'Neill soils have sand and gravel underlying material and occur above Mariaville soils. Paka soils have weathered siltstone at depths of 40 to 60 inches. They occur in positions similar to those of Mariaville soils, but generally on lesser side slopes.

Typical pedon of Mariaville loam, in an area of Mariaville-Paka loams, 15 to 40 percent slopes, 1,000 feet west and 100 feet south of northeast corner sec. 15, T. 34 N., R. 15 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many medium and fine roots; few fine distinct lime concretions; 5 percent calcium carbonate equivalent; slight effervescence; mildly alkaline; clear smooth boundary.

AC—5 to 12 inches; light olive brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; many fine and medium roots; 9 percent calcium carbonate equivalent; strong effervescence; moderately alkaline; clear irregular boundary.

C1—12 to 17 inches; light yellowish brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; weak fine and medium subangular blocky siltstone fragments; hard, firm; few to common very fine and fine roots; few fine distinct lime accumulations; 10 percent calcium carbonate equivalent; violent effervescence; moderately alkaline; clear smooth boundary.

Cr1—17 to 22 inches; light yellowish brown (2.5Y 6/4) siltstone, light olive brown (2.5Y 5/4) moist; massive; fine and medium angular blocky siltstone accumulations interspersed in pores and between bedding planes; 12 percent calcium carbonate equivalent; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr2—22 to 60 inches thick; light yellowish brown (2.5Y 6/4) siltstone, light olive brown (2.5Y 5/4) moist; few to common fine distinct black (10YR 2/1) mottles dispersed throughout the matrix; massive; medium and coarse angular blocky siltstone fragments; very hard, firm; few fine soft lime accumulations; 12 percent calcium carbonate equivalent; few dark concretions of Fe and Mn oxides; strong effervescence; moderately alkaline.

Depth to siltstone is 10 to 20 inches. The average clay content in the control section ranges from 20 to 30 percent.

The A horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 2. It is loam or silt loam. It ranges from neutral to mildly alkaline. The AC horizon has hue of 10YR or 2.5Y, value of 4 through 6 (3 through 5 moist), and chroma of 2 through 4. It is loam, silt loam, or silty clay loam. It ranges from mildly alkaline to moderately alkaline.

The C1 horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It is silt loam, loam, or silty clay loam. Reaction ranges from mildly to moderately alkaline. The Cr horizon has color value of 6 through 8 (5 through 7 moist) and chroma of 2 through 4. It is soft siltstone, easily penetrated, but becomes hard when exposed to air.

Meadin series

The Meadin series consists of excessively drained, rapidly permeable soils. These soils are on gravelly uplands, low ridges, terrace breaks, alluvial fans, and foot slopes. The soils formed in loamy material over gravelly material. Slopes range from 3 to 17 percent.

Meadin soils are commonly adjacent to Brocksburg, Jansen, Mariaville, O'Neill, and Paka soils. Brocksburg

and Jansen soils are moderately deep over gravel. They have a fine-loamy over sandy or sandy-skeletal control section and occur above the Meadin soils. O'Neill soils are moderately deep over gravel and have a coarse-loamy over sandy or sandy-skeletal control section. They occur below areas of Meadin soils. Paka and Mariaville soils developed over siltstone material. They are below the Meadin soils on the landscape.

Typical pedon of Meadin sandy loam, 3 to 17 percent slopes, 1,980 feet north and 50 feet east of southwest corner sec. 32, T. 35 N., R. 15 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; slightly acid; gradual smooth boundary.

AC—8 to 13 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; weak medium to coarse subangular blocky structure parting to weak fine subangular blocky and single grain; slightly hard, friable; 30 percent, by volume, fine and medium gravel up to 15 mm in diameter; slightly acid; gradual wavy boundary.

IIC1—13 to 26 inches; yellowish brown (10YR 5/6) very gravelly coarse sand, yellowish brown (10YR 5/4) moist; single grained; loose; 49 percent, by volume, gravel up to 1 inch in diameter; neutral; gradual wavy boundary.

IIC2—26 to 60 inches; very pale brown (10YR 7/3) gravelly coarse sand, pale brown (10YR 6/3) moist; single grained; loose; 34 percent, by volume, gravel up to 1 inch in diameter; neutral.

The thickness of the solum ranges from 8 to 20 inches. The control section is, on a weighted average, more than 35 percent gravel.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It dominantly is sandy loam but ranges to loam and fine sandy loam. The AC horizon has color value of 4 through 6 (3 or 4 moist) and chroma of 2 through 4. It is sandy loam, gravelly sandy loam, loamy sand, gravelly loamy sand, and gravelly sand. It is 10 to 35 percent gravel by volume.

The IIC horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. It is very gravelly and gravelly coarse sand. It is 30 to 70 percent gravel by volume.

Nora series

The Nora series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in recent loess material on convex ridges and hillsides. Slopes range from 2 to 11 percent.

Nora soils are commonly adjacent to Crofton, Eltree, and Paka soils. Crofton soils are steeper and do not have a mollic epipedon. Eltree soils are nearly level and have a mollic epipedon thicker than 20 inches. Paka soils formed in weathered siltstone sediments.

Typical pedon of Nora silt loam, 2 to 6 percent slopes, 1,900 feet south and 100 feet west of northeast corner sec. 33, T. 34 N., R. 9 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

B1—7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse blocky structure parting to weak medium and fine granular; slightly hard, friable; mildly alkaline, clear smooth boundary.

B21—13 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse blocky structure parting to weak medium and fine subangular blocky; slightly hard, friable; dispersed lime accumulations; slight effervescence; mildly alkaline; clear smooth boundary.

B22ca—15 to 22 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse blocky structure parting to weak medium subangular blocky; hard, friable; common distinct soft lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

B3ca—22 to 34 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; hard, friable; dispersed lime accumulations; violent effervescence; moderately alkaline.

Cca—34 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; very weak coarse subangular blocky structure; soft very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 34 inches. Depth to carbonates is 13 to 24 inches. Thickness of the mollic epipedon ranges from 7 to 14 inches and extends into the B horizon in some pedons.

The A horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 2. Reaction is generally neutral but is mildly alkaline in some pedons.

The B horizon has color value of 4 through 6 (3 or 4 moist) and chroma of 2 to 4. It is silt loam or light silty clay loam that averages between 18 and 25 percent clay. Reaction is mildly alkaline or moderately alkaline.

The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 3 or 4. Few or common lime accumulations are in the lower part of the B horizon and the upper part of the C horizon.

Onawa series

The Onawa series consists of deep, somewhat poorly drained, slowly over moderately rapidly permeable soils on bottom lands in the Missouri River Valley. These soils formed in recently deposited clayey alluvium underlain by silty material. They are occasionally flooded. The slope is 0 to 2 percent.

Onawa soils are adjacent to Albaton, Blake, Haynie, and Inavale soils. Albaton soils are clayey throughout the profile and are on lower levels. Blake soils have less clay in the upper 2 feet, and Haynie soils are silty throughout. Inavale soils are sandy throughout. All of these soils are higher in elevation than Onawa soils.

Typical pedon of Onawa silty clay, 0 to 2 percent slopes, 600 feet south and 100 feet west of center sec. 20, T. 34 N., R. 9 W.

Ap—0 to 7 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak medium blocky structure parting to weak fine granular; very hard, firm; mildly alkaline; abrupt smooth boundary.

C1g—7 to 16 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; common fine prominent mottles in the lower part, dark reddish brown (5YR 3/5) moist; moderate coarse subangular blocky structure parting to moderate medium and fine angular blocky; hard, firm; mildly alkaline; clear smooth boundary.

C2g—16 to 28 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; few fine and medium distinct dark yellowish brown (10YR 4/4) mottles, strong brown (7.5YR 5/6) moist; moderate fine angular blocky structure with some horizontal cleavage planes parting to strong angular blocky in the lower part; hard, firm; mildly alkaline; abrupt smooth boundary.

IIC3g—28 to 60 inches; stratified light brownish gray (2.5Y 6/2) and gray (10YR 5/1) silt loam and thin layers of clayey material, dark gray (10YR 4/1) moist; common to many medium distinct yellowish brown (10YR 5/6) mottles, dark reddish brown (5YR 3/4) moist; some horizontal cleavage planes; slightly hard, friable; moderately alkaline.

The thickness of the solum, the A1 or Ap horizon, is 7 to 10 inches. The control section is silty clay or clay to depths ranging from 18 to 30 inches, and the lower part is silt loam or very fine sandy loam. Mottles of 10YR or 5YR hue and high value and chroma are present throughout the control section.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2.

The Cg horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2. It is clay or silty clay. It commonly has strata of silt loam or very fine sandy loam. Distinct and prominent mottles range from few to common. The IICg horizon is typically silt loam or very fine sandy loam.

O'Neill series

The O'Neill series consists of well drained soils on uplands. Permeability is moderately rapid in the solum and very rapid in the underlying material. These soils formed in loamy outwash or eolian material over sand and gravel. Slopes range from 0 to 9 percent.

O'Neill soils are commonly adjacent to Anselmo, Brocksburg, Dunday, Jansen, Meadin, Simeon, and Valentine soils. Anselmo soils are deeper than O'Neill soils and do not have gravelly underlying material. Brocksburg and Jansen soils have a loam or clay loam argillic horizon. Dunday soils have a sandy control section and do not have gravelly underlying material. Meadin soils are less than 20 inches deep over gravel. Simeon and Valentine soils do not have a mollic epipedon.

Typical pedon of O'Neill fine sandy loam, 2 to 6 percent slopes, 2,200 feet west and 700 feet south of northeast corner sec. 7, T. 34 N., R. 16 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

A12—6 to 9 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable; common fine roots; slightly acid; clear smooth boundary.

B21—9 to 15 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse blocky structure parting to weak fine subangular blocky; slightly hard, friable; common fine roots; slightly acid; clear smooth boundary.

B22—15 to 26 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; slightly acid; clear smooth boundary.

IIC1—26 to 34 inches; yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to single grained; soft, very friable; neutral; clear smooth boundary.

IIC2—34 to 42 inches; light yellowish brown (10YR 6/4) gravelly coarse sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral; clear smooth boundary.

IIC3—42 to 60 inches; very pale brown (10YR 7/3) gravelly sand, brown (10YR 5/3) moist; single grained; loose; neutral.

The thickness of the solum ranges from 20 to 30 inches but typically is about 26 inches. Thickness of the mollic epipedon ranges from 7 to 14 inches. Reaction ranges from slightly acid to neutral.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is fine sandy loam and loam.

The B horizon has color value of 4 or 5 (3 or 4 moist) and chroma from 2 through 4. Texture is fine sandy loam or sandy loam. In some pedons there is a noticeable accumulation of clay just above the coarse underlying material.

The IIC horizon has color value of 5 through 7 (4 or 5 moist) and chroma of 3 or 4. It is gravelly sandy loam in the upper part and coarse sand and gravelly sand in the lower part.

Onita series

The Onita series consists of deep, well drained or moderately well drained, moderately slowly permeable soils on uplands. These soils formed in loamy and clayey alluvium and loesslike material. Slopes are 0 to 2 percent.

Onita soils are commonly adjacent to Anselmo, Brocksburg, Paka, Ree, and Reliance soils. Anselmo soils have a coarse-loamy control section and have a mollic epipedon less than 20 inches thick. Brocksburg and Ree soils are less than 35 percent clay in the argillic horizon, and Brocksburg soils have sand or gravel within a depth of 40 inches. Reliance soils have a mollic epipedon less than 20 inches thick and are slightly higher on the landscape. Paka soils have weathered siltstone at depths of 40 to 60 inches.

Typical pedon of Onita silt loam, 0 to 2 percent slopes, 900 feet south and 50 feet east of northwest corner sec. 11, T. 34 N., R. 15 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A12—7 to 18 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; slightly acid; gradual smooth boundary.

B21t—18 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to medium and fine subangular blocky; slightly hard, friable; common organic stains on ped faces; neutral; gradual smooth boundary.

B22t—25 to 32 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate subangular blocky; hard, firm; few organic stains on ped faces; neutral; clear smooth boundary.

B3—32 to 38 inches; light olive brown (2.5Y 5/3) silt loam, olive brown (2.5Y 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm; few lime segregations; slight effervescence; moderately alkaline; gradual smooth boundary.

C1ca—38 to 49 inches; olive (5Y 5/3) silt loam, olive (5Y 4/3) moist; few faint iron stains; weak coarse prismatic structure; slightly hard, friable; diffused lime in pores and root channels; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—49 to 60 inches; pale olive (5Y 6/4) loam, olive (5Y 4/3) moist; common distinct strong brown (7.5YR 5/6) iron stains; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 28 to 48 inches. Depth to free lime ranges from 30 to 40 inches. Thickness of the mollic epipedon ranges from 22 to 34 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam, but in some pedons it is silty clay loam. It is slightly acid or neutral.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The texture is silty clay loam or silty clay.

The C horizon ranges from loam to silty clay loam or clay. Some pedons have a substratum of fine sandy loam.

Ord series

The Ord series consists of deep, somewhat poorly drained soils on bottom lands and in upland depressions. These soils formed in stratified sandy alluvium. They are occasionally flooded. Permeability is moderately rapid. The slope is 0 to 2 percent.

Ord soils are commonly associated with Barney, Cass, Grigston, Inavale, and Leshara soils. Barney soils have a higher water table than Ord soils and are at lower elevations nearer the stream channel. Cass and Inavale soils are better drained and occur at slightly higher elevations. In addition, Inavale soils do not have a mollic epipedon. Grigston soils have a fine-silty control section, are better drained than Ord soils, and occur at slightly higher levels. Leshara soils have a fine-silty control section and occur in positions similar to those of Ord.

Typical pedon of Ord fine sandy loam, 0 to 2 percent slopes, 2,300 feet east and 50 feet south of northwest corner sec. 5, T. 33 N., R. 15 W.

A11—0 to 6 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

A12—6 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable; slightly acid; clear smooth boundary.

AC1—11 to 24 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine distinct reddish brown (5YR 4/4) mottles in the lower part of this horizon; weak coarse blocky structure parting to weak medium and fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

AC2—24 to 30 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; very few fine distinct reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

C1—30 to 34 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

C2—34 to 60 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grained; loose; thin strata of finer textured material; free water at 50 inches; neutral.

Thickness of the solum ranges from 20 to 35 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches. The soil is slightly acid or neutral in the upper part and neutral or mildly alkaline in the lower part.

The A horizon has color value of 4 or 5 (3 moist) and chroma of 1 or 2. It is typically fine sandy loam, but loam, loamy sand, and loamy fine sand are within the range. The AC horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2. There are a few faint to distinct reddish brown mottles in the lower part of this horizon in some pedons. Some pedons have an A1b horizon.

The upper part of the C horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2. Texture ranges from loamy sand to sandy loam. The lower part of the C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 2 or 3. Texture is dominantly sand but includes fine sand and coarse sand.

Paka series

The Paka series consists of deep, well drained, moderately permeable soils formed in loamy or silty materials weathered from siltstone. These soils occur on plane and convex surfaces and on rounded ridgetops and side slopes. The slope ranges from 0 to 40 percent.

Paka soils are commonly adjacent to Labu, Mariaville, Onita, and Reliance soils. Labu soils are finer textured, formed in material weathered from shale, and occupy the lower side slopes. Mariaville soils have weathered siltstone within a depth of 20 inches. They generally occur below Paka soils on steep side slopes bordering larger drainageways. Onita and Reliance soils formed in loess, have a fine textured subsoil, and occur above Paka soils.

Typical pedon of Paka loam, 6 to 11 percent slopes, 1,584 feet south and 792 feet east of northwest corner sec. 15, T. 34 N., R. 16 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; slightly hard, friable; many medium and fine roots; neutral; clear irregular boundary.

B21t—8 to 16 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, firm; common fine roots; thin patchy clay films on faces of peds and common dark grayish brown (10YR 4/2) tongues of A horizon on ped faces; mildly alkaline; clear irregular boundary.

B22t—16 to 21 inches; pale brown (10YR 6/3) clay loam, grayish brown (10YR 5/2) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; very hard, very firm; few fine roots; thin continuous clay films on peds; mildly alkaline; clear smooth boundary.

B3ca—21 to 26 inches; light gray (10YR 7/2) silty clay loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; very hard, very firm; few fine roots; 4 percent calcium carbonate; moderately alkaline; strong effervescence; clear smooth boundary.

C1—26 to 48 inches; very pale brown (10YR 8/3) silt loam weathered from siltstone; pale brown (10YR 6/3) moist; massive; hard, friable; 6 percent calcium carbonate; moderately alkaline; strong effervescence; gradual smooth boundary.

Cr—48 to 60 inches; very pale brown (10YR 7/3) weakly cemented siltstone, silt loam when crushed, pale brown (10YR 6/3) moist; massive; hard, friable; 6 percent calcium carbonate; moderately alkaline; strong effervescence.

The thickness of the solum typically is 25 to 30 inches but ranges from 20 to 38 inches. Depth to siltstone bedrock is 40 to 60 inches. Depth to free carbonates ranges from 16 to 30 inches.

The A horizon has color value of 3 or 4 (2 or 3 moist) and chroma of 2 or 3. It is loam or fine sandy loam.

The B2t horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3. It is silt loam, clay loam, or silty clay loam and averages between 24 and 32 percent clay. It is mildly or moderately alkaline. The B3ca horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It is silty clay loam, clay loam, or loam. It is mildly or moderately alkaline.

The C1 horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 7 or 8 (5 through 7 moist), and chroma of 2 through 4. It is silt loam or very fine sandy loam weathered from siltstone. It is mildly or moderately alkaline. The Cr horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 7 or 8 (6 or 7 moist), and chroma of 2 through 4. It is mildly to moderately alkaline.

Promise series

The Promise series consists of deep, well drained, slowly and very slowly permeable soils on uplands. These soils formed in clay sediments weathered from Pierre Shale. The slope ranges from 2 to 6 percent.

Promise soils are similar to Verdel soils and are commonly associated with Boyd and Labu. Boyd and Labu soils have bedded shale within a depth of 40 inches and occur higher in the landscape. Verdel soils contain less clay in the control section and occur lower in the landscape.

Typical pedon of Promise silty clay, 2 to 6 percent slopes, 2,400 feet north and 50 feet west of southeast corner sec. 16, T. 33 N., R. 9 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure parting to moderate medium and fine granular; very hard, friable; mildly alkaline; abrupt smooth boundary.

A12—6 to 9 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure parting to moderate medium subangular; very hard, very firm; mildly alkaline; abrupt smooth boundary.

B21—9 to 18 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium and fine angular blocky; extremely hard, extremely firm; slight effervescence; moderately alkaline; clear smooth boundary.

B22ca—18 to 27 inches; gray (5Y 5/1) clay, dark olive gray (5Y 3/2) moist; strong coarse prismatic structure parting to strong medium angular blocky; extremely hard, extremely firm; few soft masses of lime accumulations; violent effervescence; moderately alkaline; clear smooth boundary.

B3ca—27 to 33 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; strong coarse angular blocky structure parting to strong medium and fine angular blocky; extremely hard, extremely firm; common soft medium and fine distinct lime accumulations; violent effervescence; moderately alkaline; clear smooth boundary.

C1—33 to 48 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; massive; extremely hard, extremely firm; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; massive; very hard, very firm; few shale fragments; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 35 inches. Depth to free carbonates typically ranges from 9 to 14 inches, but some pedons are calcareous to the surface. The clay content in the control section is between 60 and 65 percent.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay, but in some pedons it is clay. It is neutral or mildly alkaline.

The B horizon has 2.5Y or 5Y hue, value of 4 or 5 (3 or 4 moist), and chroma of 1 to 3. It is clay or silty clay. It is extremely hard or very hard and extremely firm or very firm.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is typically clay or silty clay but includes coarser sediments in some pedons.

Ree series

The Ree series consists of deep, well drained, moderately permeable soils on thinly mantled loess uplands. These soils formed in loamy and silty material underlain by sandy material. The slope ranges from 2 to 15 percent.

Ree soils are commonly adjacent to Anselmo, Eltree, Nora, Onita, and Reliance soils. Anselmo soils have a coarse-loamy control section. Eltree and Onita soils have flatter slopes and a mollic epipedon thicker than 20 inches. Eltree and Nora soils do not have an argillic horizon. Reliance soils have a higher clay content in the control section and do not have sandy underlying material.

Typical pedon of Ree silt loam, 2 to 6 percent slopes, 530 feet north and 50 feet west of southeast corner sec. 7, T. 34 N., R. 13 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B21t—7 to 14 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; shiny coatings on faces of peds; many tongues of dark grayish brown (10YR 4/2) extending into this horizon along cracks and ped faces; neutral; clear wavy boundary.

B22t—14 to 22 inches; grayish brown (10YR 5/2) light clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; hard, friable; shiny coatings on faces of peds; neutral; clear wavy boundary.

IIB3—22 to 25 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; slightly hard, very friable; mildly alkaline; abrupt wavy boundary.

IIC1ca—25 to 40 inches; pale brown (10YR 6/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure; soft, very friable; few small lime accumulations; strong effervescence; moderately alkaline; clear wavy boundary.

IIC2—40 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 17 to 36 inches. Depth to free carbonates ranges from 18 to 30 inches. The mollic epipedon is 7 to 14 inches thick.

The A horizon has color value of 3 through 5 (2 or 3 moist) and chroma of 2. It is commonly silt loam but is loam in some pedons. It is slightly acid or neutral.

The B2t horizon has 10YR or 2.5Y hue, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is commonly silty clay loam but is sandy clay loam and clay loam in some pedons. It has an average clay content of 27 to 35 percent. It is neutral or mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4. It contains few to many lime segregations. It ranges from loam to sandy loam in the upper part and from fine sandy loam to loamy fine sand in the lower part. It is mildly to moderately alkaline.

Reliance series

The Reliance series consists of deep, well drained, moderately slowly permeable soils on loess covered uplands. The slope ranges from 2 to 11 percent.

Reliance soils are associated with Anselmo, Eltree, Nora, Onita, Paka, and Ree soils on the landscape. Anselmo soils have a coarse-loamy control section. Eltree and Onita soils have a mollic epipedon thicker than 20 inches and occur on nearly level landscapes. Eltree and Nora soils lack an argillic horizon. Ree and Paka soils have less clay in the control section. Ree soils have sandy underlying material.

Typical pedon of Reliance silt loam, 2 to 6 percent slopes, 900 feet west and 1,320 feet south of northeast corner sec. 33, T. 34 N., R. 10 W.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak medium and fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—10 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, friable; mildly alkaline; clear smooth boundary.

B22t—14 to 18 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

B23—18 to 28 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

B3ca—28 to 34 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium and fine angular blocky; hard, firm; few soft prominent lime segregations; violent effervescence; moderately alkaline; clear smooth boundary.

C1ca—34 to 50 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; hard, friable; many soft prominent lime segregations; violent effervescence; moderately alkaline; clear smooth boundary.

IIC2—50 to 60 inches; light yellowish brown (10YR 6/4) fine sandy loam; yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; few soft prominent lime segregations; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 40 inches. The mollic epipedon is 10 to 16 inches thick and in places extends into the B21t horizon. Depth to free carbonates is 24 to 34 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam and neutral or slightly acid.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 through 4. Clay content ranges from 35 to 45 percent. Reaction is neutral or mildly alkaline. The B3 horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 4. It is mildly alkaline in the upper part and moderately alkaline in the lower part.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 3 or 4. In some pedons the C horizon between 40 and 60 inches is underlain by clay, bedded shale, sand or gravel, or siltstone.

The Reliance silty clay loam map unit is not within the range defined for the Reliance series because it lacks a sufficient increase of clay in the B horizon as compared with the clay content in the A horizon. This difference does not alter the use or behavior of the soil.

Sansarc series

The Sansarc series consists of shallow, well drained, slowly permeable soils on residual uplands. These soils formed in material weathered from shale (fig. 17). The slope ranges from 11 to 40 percent.

Sansarc soils are similar to Bristow soils and are commonly adjacent to Boyd, Labu, Lynch, and Promise soils. Bristow and Lynch soils formed in lighter colored shale and contain more calcium carbonate and gypsum. They normally occur below the Sansarc soils. Boyd, Labu, Lynch, and Promise soils are not so steep as Sansarc soils, and bedded shale is deeper in the profile.

Typical pedon of Sansarc silty clay, 20 to 40 percent slopes, 1,320 feet west and 1,000 feet north of southeast corner sec. 32, T. 33 N., R. 9 W.

A1—0 to 5 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse subangular blocky structure parting to moderate medium and fine granular; hard, friable; moderately alkaline; clear smooth boundary.

C1—5 to 11 inches; grayish brown (2.5Y 5/2) shaly clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to moderate fine and very fine platy; very hard, very firm; common fine soft lime accumulations; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—11 to 16 inches; light olive gray (5Y 6/2) shaly clay, olive gray (5Y 5/2) moist; weak coarse subangular blocky structure parting to medium and fine platy; extremely hard, extremely firm; common medium lime accumulations; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—16 to 60 inches; pale olive (5Y 6/4) bedded shale, olive (5Y 5/3) moist; massive; few iron stains in seams of the shale; many large shale rocks below 26 inches; shale partings have slight effervescence, clay masses have violent effervescence; moderately alkaline.

Depth to bedded shale typically is 10 to 16 inches but ranges from 8 to 20 inches. Mollic colors extend to a depth of 4 to 6 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2. It is dominantly silty clay but ranges to clay.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 4. Texture is shaly clay or clay.

Scott series

The Scott series consists of deep, very poorly drained, very slowly permeable soils in the bottoms of upland depressions. These soils formed in loess and in loess reworked by water. The slope is 0 to 1 percent.

Scott soils are commonly adjacent to Onita, Ree, and Reliance soils. All those soils are better drained and lack an A2 horizon and the mottling in the lower horizons, which characterize the Scott soils. Ree soils also have a fine-loamy control section. All three soils occur at higher elevations.

Typical pedon of Scott silt loam, 0 to 1 percent slopes, 1,600 feet east and 100 feet north of southwest corner sec. 4, T. 33 N., R. 12 W.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; common fine to medium distinct yellowish brown (10YR 5/6) mottles; weak medium granular structure; slightly hard, friable; plentiful roots; medium acid; clear smooth boundary.

A12—4 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium blocky structure parting to weak medium granular; slightly hard, friable; few fine roots; slightly acid; abrupt smooth boundary.

A2—6 to 8 inches; gray (10YR 6/1) silt loam; dark gray (10YR 4/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium platy structure parting to moderate fine subangular blocky; slightly hard, friable; neutral; abrupt smooth boundary.

B2t—8 to 48 inches; gray (10YR 5/1) silty clay; very dark gray (10YR 3/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; strong coarse prismatic structure parting to strong medium blocky; very hard, very firm; neutral; clear smooth boundary.

C1—48 to 56 inches; light grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; few faint iron stains; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, very firm; violent effervescence; mildly alkaline; clear smooth boundary.

C2—56 to 64 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; massive; hard, firm; moderately alkaline.

The thickness of the solum ranges from 28 to 48 inches. The depth to free lime ranges from 36 to 56 inches.

The A1 horizon has color value of 4 or 5 dry (2 or 3 moist), and chroma of 1 or 2. The A2 horizon has color value of 5 through 6 (4 or 5 moist) and chroma of 1.

The B2t horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silty clay or clay averaging between 40 and 55 percent. In some profiles it contains ferromanganese pellets.

The C horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. Texture is silt loam, clay loam, and silty clay loam.

Simeon series

The Simeon series consists of deep, excessively drained, rapidly permeable soils. These soils formed in sandy alluvium and outwash material. They occur on geologic benches or terraces along the Niobrara River and Ponca Creek. The benches are 100 to 150 feet high above the flood plain. Slopes range from 0 to 30 percent.

Simeon soils are commonly adjacent to Brocksburg, Dunday, Labu, O'Neill, and Valentine soils. Brocksburg, Dunday, and O'Neill soils have a mollic epipedon and a finer textured control section than Simeon soils. All occupy lower levels on the landscape. Valentine soils are commonly fine sand, less than 35 percent medium sand and less than 10 percent coarser sand and very coarse sand. Labu soils developed in shaly clay and are on lower side slopes of drainageways.

Typical pedon of Simeon loamy sand in an area of Simeon-Valentine complex, 3 to 30 percent slopes, eroded; 550 feet south and 50 feet east of northwest corner sec. 9, T. 33 N., R. 11 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; slightly hard, very friable; many fine roots; neutral; clear smooth boundary.

AC—5 to 10 inches; brown (10YR 5/3) loamy coarse sand; dark brown (10YR 4/3) moist; single grained; loose; many fine roots; neutral; gradual smooth boundary.

C1—10 to 14 inches; pale brown (10YR 6/3) coarse sand, brown (10YR 5/3) moist; single grained; loose; 6 to 11 percent fine gravel pebbles; neutral; gradual smooth boundary.

C2—14 to 60 inches; very pale brown (10YR 7/4) coarse sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral.

The thickness of the solum ranges from 7 to 18 inches. Simeon soils are slightly acid or neutral and lack free carbonates.

The A horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2. It is typically loamy sand but includes sand and fine sand. The AC horizon has color value of 4 through 6 (4 through 5 moist) and chroma of 3.

The C horizon has color value of 6 or 7 (5 through 7 moist) and chroma of 3 or 4. Gravel content ranges to as much as 15 percent by volume. Texture is loamy coarse sand, sand, and coarse sand that are more than 35 percent medium and coarse sand.

Map units Sm and SuC lack significant coarse fragments and are more strongly developed. These differences do not alter the use or behavior of the soils.

Valentine series

The Valentine series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in eolian sands. Slopes range from 0 to 30 percent.

Valentine soils are adjacent to Dunday, Ord, Simeon, and Wewela soils. Dunday soils have a mollic epipedon and typically are loamy fine sand throughout the control section. They generally are lower on the landscape. Ord soils are somewhat poorly drained. Wewela soils have a finer textured subsoil and are underlain by shale. Both are in slight depressions. Simeon soils have a coarser textured control section containing gravel and coarse sand. They are in nearly level and gently sloping areas between the sandhills and on the upper side slopes of the breaks along drainageways.

Typical pedon of Valentine fine sand, rolling, 1,700 feet west and 300 feet north of southeast corner sec. 33, T. 34 N., R. 16 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; very weak fine subangular blocky structure parting to single grained; soft, very friable; neutral; clear smooth boundary.

AC—5 to 11 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; soft, very friable; neutral; gradual smooth boundary.

C—11 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; neutral.

The thickness of the solum ranges from 9 to 14 inches. Texture of the profile is typically fine sand or loamy sand but includes loamy fine sand and sand. The loamy sand and sand are less than 35 percent medium sand and less than 10 percent coarse sand or very coarse sand. The soil is slightly acid or neutral throughout.

The A horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2. The AC horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3.

The C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 3 or 4.

Verdel series

The Verdel series consists of deep, well drained, slowly and very slowly permeable soils on terraces. These soils formed in clayey alluvium derived from residual Pierre Shale. The slope is 0 to 2 percent.

Verdel soils are similar to Promise soils and are commonly adjacent to Boyd, Hall, Labu, Lynch, and Promise soils. Boyd, Labu, and Lynch soils, on the higher convex slopes, are 20 to 40 inches deep over shale. Labu and Lynch soils lack a mollic epipedon. Hall soils are at slightly lower elevations and have less clay in the solum. Promise soils are at slightly higher elevations and have more clay in the control section.

Typical pedon of Verdel silty clay, 0 to 2 percent slopes, about 700 feet north and 800 feet west of center sec. 11, T. 34 N., R. 13 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) light silty clay, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine and very fine granular; hard, friable; many fine roots; slightly acid; abrupt smooth boundary.

A12—7 to 14 inches; dark grayish brown (10YR 4/2) silty clay; very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, friable; many fine roots; slightly acid; clear smooth boundary.

B1—14 to 20 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, friable; many fine roots; neutral; clear smooth boundary.

B21—20 to 28 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium subangular blocky structure parting to strong fine blocky; very hard, firm; few fine segregations of lime; slight effervescence; mildly alkaline; abrupt smooth boundary.

B22—28 to 40 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to strong fine blocky; very hard, firm; common fine segregations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—40 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm; common medium segregations of lime; strong effervescence; moderately alkaline.

The thickness of the solum typically is 28 to 40 inches but ranges from 25 to 55 inches. Free carbonates generally are at depths of 20 to 30 inches. The mollic epipedon is 20 to 30 inches thick and includes part of the B horizon.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. In most pedons it is silty clay, but the range is from silty clay loam to clay. Reaction is slightly acid or neutral.

The B horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. The texture is silty clay or clay. The clay content is 40 to 50 percent. Reaction ranges from neutral to moderately alkaline.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 1 to 4. It is silty clay or clay. It is moderately alkaline or strongly alkaline.

Wewela series

The Wewela series consists of moderately deep, well drained, moderately permeable over very slowly permeable soils on uplands. These soils formed in loamy material over clayey shale. Slopes range from 2 to 6 percent.

Wewela soils are adjacent to Dunday, Labu, Ord, Paka, Simeon, and Valentine soils. Dunday, Simeon, and Valentine soils are sandy and are not underlain by shale within a depth of 40 inches. They occur slightly higher on the landscape. Labu soils are fine textured and do not have loamy material in the upper part of the profile. In addition, they do not have a mollic epipedon, and they occur on lower slopes. Ord soils are coarse-loamy and are somewhat poorly drained. They are on slightly lower levels. Paka soils formed in loamy material and do not have clayey material within a depth of 40 inches. They occupy positions similar to those of Wewela soils.

Typical pedon of Wewela fine sandy loam, 2 to 6 percent slopes, 1,600 feet south and 100 feet east of northwest corner sec. 8, T. 33 N., R. 16 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak medium and fine granular; slightly hard, friable; plentiful roots; neutral; clear smooth boundary.

B2t—8 to 15 inches; brown (10YR 5/3) sandy clay loam; dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; hard, firm; neutral; gradual wavy boundary.

IIB3—15 to 22 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; moderate coarse blocky structure parting to moderate medium and fine subangular blocky; very hard, very firm; some tonguing of A material on ped faces; neutral; gradual wavy boundary.

Cr—22 to 60 inches; light yellowish brown (2.5Y 6/4) shaly clay, light olive brown (2.5Y 5/4) moist; massive, extremely hard, extremely firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 14 to 22 inches. The mollic epipedon is 7 to 10 inches thick and extends into the upper part of the B2t horizon in some pedons. Depth to free carbonates ranges from 18 to 30 inches, and depth to bedded shale ranges from 20 to 30 inches. Some tonguing of the A horizon extends through the solum in most pedons.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2. It commonly is fine sandy loam but is loam or loamy fine sand in some pedons.

The B2t horizon has hue of 10YR or 2.5Y, value of 5 or 6 (3 through 5 moist), and chroma of 2 through 4. It is clay loam, loam, or sandy clay loam that averages between 25 and 35 percent clay. The IIB3 horizon has hue of 10YR or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 8. It averages between 45 and 55 percent clay.

The Cr horizon is 2.5Y or 5Y hue, value of 5 or 6 (4 or 5 moist), and chroma of 2 through 8. It is shaly clay in the upper part grading to bedded shale in the lower part.

Formation of the soils

The characteristics of a soil in any given place are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and can determine it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material, the unconsolidated mineral material from which a soil forms, determines the chemical and mineralogical composition of the soil. In Boyd County, the soils formed in material weathered from the underlying geologic formations or in material transported by wind and water.

The oldest geologic exposures that affect soil development are the Niobrara Formation and the Pierre Shale, both of which are of Cretaceous age. The Niobrara, the older of the two formations, is exposed only at the base of the bluffs along the Missouri River Valley. It consists of shaly limestone, calcareous shale, chalk, and limestone.

Much of the exposure occurs as nearly vertical banks with little or no soil development. In a few of the less sloping areas, Bristow soils formed.

The Pierre Shale, which overlies the Niobrara Formation, extends throughout Boyd County. It can be subdivided into three members, which in ascending order are an unnamed member, the Mobridge Member, and the Elk Butte Member.

The lower unnamed member is a dark gray bentonitic shale. It is exposed only in the eastern part of the county. The largest exposure is along bluffs in the Missouri River Valley. This shale consists of marine deposits and weathers to fine textured soil material. The Boyd, Labu, and Sansarc soils formed in this material. Promise soils formed in colluvium derived from the weathered shale.

The Mobridge Member of the Pierre occurs as beds of shaly chalk and calcareous shale that are medium to dark gray when exposed and weather to yellowish brown and yellowish orange. It is 160 to 200 feet thick and is exposed along the valley sides of Ponca Creek and the Niobrara River as far west as the central part of Boyd County. This shale weathers to fine-textured soil material that is high in lime and gypsum. The Bristow and Lynch soils formed in this material. Both have the yellowish brown colors characteristic of the parent shale.

The Elk Butte Member consists mostly of dark gray shale and claystone. It extends across the entire county. Where exposed, this member weathers to an olive-brown clay. Soils formed in this weathered material are the Boyd, Labu, Sansarc, and Promise.

The next oldest rock units in Boyd County are of tertiary age. They overlie the Pierre Shale throughout much of the upland area. These formations consist mainly of siltstone beds. They outcrop throughout the northeast, south-central, and western parts of the county. The Paka and Mariaville soils formed in the material weathered from these siltstone rock units.

Unconsolidated deposits of clay, silt, sand, and gravel were laid down in widely differing topographic positions during Quaternary time. Streams and wind were the agents of deposition.

Areas of wind deposited silty material or loess occur throughout much of the upland of the county. The loess, a friable, massive, yellowish brown material, forms a thin mantle, generally less than 10 feet thick. It is calcareous and contains a few lime concretions. Crofton, Eltree, Nora, Onita, and Reliance soils formed in this parent material. Loess forms the upper part of Ree soils and is part of the surface layer of Brocksburg, Hall, Jansen, and Paka soils. The Scott soils in upland depressions formed in loess that had been modified by water.

The sand deposits in Boyd County are of stream and wind deposition. Most of these areas, the high terraces along valleys of the present day streams, are remnants of the alluvium deposited before the streams cut down to their present level. Simeon and O'Neill soils formed on these high terrace uplands. Many of these areas were subsequently reworked by wind action into low hummocks and dunes. The material is loose, single grained, pale brown or very pale brown fine sandy loam, loamy fine sand, or fine sand. Anselmo, Blendon, Dunday, and Valentine soils formed in deep deposits of this parent material. The upper part of Paka fine sandy loam and Wewela fine sandy loam also formed in eolian sand. Some Inavale and Blendon soils formed in eolian sands on stream terraces and bottom lands.

Colluvium is material that accumulates as a result of the combined forces of gravity and water. This parent material in Boyd County is on foot slopes at the base of hills in the clayey uplands. Promise soils and the upper part of the Verdel soils formed in this clayey material. Blendon soils formed at the base of sandy uplands.

Alluvium is the parent material of soils on bottom land and stream terraces. This sandy to clayey material has been deposited by streams. The bottom land continues to receive sediments from floodwaters. Albaton, Blake, Haynie, Inavale, and Onawa soils formed in alluvium on bottom land along the Missouri River. Barney, Cass, Grigston, Inavale, Leshara, and Ord soils formed on bottom land along the rest of the streams in the county. The oldest alluvium is on stream terraces, which are above the present flood plain and are not subject to flooding. Blendon, Hall, and Verdel soils formed in this material.

Pleistocene gravel beds cap the high plains remnant in the northwestern part of the county. These gravel beds have a thin mantle of silty and loamy, alluvial and wind deposited sediments. The soils formed in this material are Brocksburg, Jansen, Meadin and O'Neill.

Climate

The climate of Boyd County, subhumid and continental, is one of light rainfall, cold winters, warm summers, high winds, and frequent changes in weather conditions. Temperatures of 100 degrees F. in summer and below zero in winter are common. The mean annual temperature is 48.5 degrees, and the average annual rainfall is 23.2 inches. The average growing season is about 150 days. Because the climate is fairly uniform throughout the county, differences in soils cannot be attributed to climate.

Climate affects weathering and soil formation directly through rainfall, changes in temperature, and wind action. In this county precipitation is not heavy enough to leach soils completely, except the sandy soils, such as Valentine and Dunday. Leaching is ordinarily limited to 2 to 3 feet in silty soils, such as Onita and Reliance, and to the top 12 inches in clayey soils, such as Boyd, Labu, and Sansarc. As water moves through the soil, it carries nutrients, clay, and organic matter from the surface horizon to the subsoil or underlying layers.

Surface flow of water caused by heavy rains continuously detaches, mixes, transports, and redeposits unconsolidated material of all kinds. The alluvial soils, such as Cass, Inavale, and Grigston, are examples of soils that formed in sediment deposited by water.

The amount of moisture and the prevailing temperature during the growing season affect the amount of vegetation, which is the principal source of organic matter. These same factors affect the chemical processes and activities of micro-organisms that convert organic matter to humus. Alternate freezing and thawing and wetting and drying speed the mechanical and chemical weathering processes and also improve the physical condition of the soil.

Wind, another important factor, transfers soil material from one place to another. The extensive deposits of loess and sand in the county are examples of the importance of wind as a soil-forming agent. The gently rolling topography of Crofton, Nora, Ree, and Reliance soils and the hummocky topography of Anselmo, Dunday, and Valentine soils can be attributed to wind activity.

Plants and animals

When the deposition and weathering of parent material slows down, bacteria, fungi, lichens, and other single forms of life invade the soil. Soon grasses and other plants take root. As soon as vegetation is established, many kinds of animals and organisms inhabitat the soil and make use of the food provided by the plant. Plants and animals are highly important in developing the chemical and physical characteristics of a soil.

The soils in Boyd County formed mostly under mid and short grasses. The fibrous root system of the grasses fills the surface layer with minute rootlets that decay and thus contribute to the supply of organic matter and improve porosity and structure of the soil. Deeper roots of prairie forbs improve the permeability of the subsoil and add a small amount of organic matter. Plant roots help in keeping the soils productive by bringing water from the deeper horizons and thus contributing soluble minerals, such as calcium, iron, phosphorus, and sulfer.

When plants decay, micro-organisms act upon the undecomposed organic matter to produce humus from which other plants can obtain nutrients. Some bacteria take nitrogen from the air and use it for their own growth. When the bacteria die, the nitrogen is available for use by plants. Insects, earthworms, and small burrowing animals influence the formation of soils by mixing the organic and mineral parts of the soils. Their burrowing activities stir the soil, mix it with fresh nutrients, and thus hasten the formation of organic matter.

The accumulation of organic matter gradually darkens the surface layer of many of the soils. In Boyd County the Eltree, Onita, and Verdel soils have a deep, darkened surface horizon, and the Crofton, Inavale, and Valentine soils have a thin, darkened surface horizon.

Man also has altered soils by the kind of management he has practiced in farming them.

Relief

Relief, or the lay of the land, affects the formation of soils through its influence on runoff, drainage, and erosion. It influences the development of soils in relatively small areas, chiefly in controlling the movement of water on the surface. The degree of slope, the shape of the surface, and the permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soils. On the steeper slopes there is greater movement of soil material downslope through creep and erosion. Ridges and hilltops are more exposed to air currents than are lower areas and are therefore more susceptible to loss of moisture by evaporation.

Steep soils have a thinner surface layer and a more weakly developed subsoil than soils on gentler slopes. The steep slopes cause rapid runoff so that only a small amount of water enters the soil. Plants grow slowly, and soil formation processes slowly. If runoff is too rapid, the surface layer may be eroded as fast as it forms. Lime is not deeply leached in soils that have steep slopes. In Boyd County, the Crofton, Bristow, Mariaville, and Sansarc soils, for example, have little development in the soil profile other than a slightly darkened, thin surface layer.

Except for the Eltree soil, most of the nearly level to strongly sloping soils that formed in loess on uplands have well developed profile characteristics. Relief affects those soils by the amount of runoff and erosion that occurs. Normally, as the degree of slope increases, the thickness of the soil profile decreases. In areas of low and flat topography, extra water is added to the soil. The extra moisture is reflected in a thick, dark colored surface layer, clearly expressed horizons, and more leaching of lime. The Onita soil is an example of these conditions in Boyd County. In depression areas, where there is no runoff, a claypan may develop in the subsoil, as in Scott soils, for example.

Soils on bottom lands and low stream terraces have little relief. Deposits have been in place such a short time that relief has had little effect. Some bottom land soils have a high water table, which affects the decay of organic material, the soil temperature, and the alkalinity. Other bottom land soils are subject to flooding and a continuous deposition of sediment. Barney, Leshara, and Ord are examples of somewhat poorly or poorly drained soils in Boyd County.

Time

Time is required for the formation of a soil. Young or immature soils are those in which the soil forming factors have not been active long enough for the formation of a soil in equilibrium with its environment. Mature or older soils have reached an equilibrium with their environment. If the land use, irrigation, or other factors change the environment, the soil establishes a new equilibrium to meet the new environment.

For soils formed in residuum, the processes of rock weathering and formation of soil horizons in the weathered parent material generally go on simultaneously. The Boyd, Bristow, Labu, Lynch, and Mariaville soils in Boyd County formed in residuum of weathered shale or siltstone.

In the transported, unconsolidated material, such as loess, sand, and alluvium, soil formation can begin as soon as the material is stabilized. The soils that formed in unconsolidated material in Boyd County range from young soils that have little or no development to old soils that have deep profiles and pronounced development.

The loess that occurs in much of the central part of the county has been in place long enough for the formation of a mature, well defined profile. Onita, Ree, and Reliance are examples of soils that have a fairly thick, darkened surface layer, have lime leached to a depth of 2 to 4 feet, and have an illuviated clay buildup in the subsoil. The Eltree soil, an example of a young soil that formed in recent eolian silt deposits along the Missouri River Valley, has little or no profile development.

Most of the sandy soils in the county have not been in place long enough for the development of well defined horizons. Examples are the Dunday, Simeon, and Valentine soils.

The alluvial soils are the youngest soils in the county. They have little or no subsoil development because their parent material has been in place for only a short time. In areas subject to flooding, deposition is still occurring.

The degree of development, or maturity, of a soil can be evaluated by soil characteristics rather than by the length of time the soil has been developing. Soil characteristics commonly used in determining the maturity of a soil are the thickness and color of the surface layer, the degree of structure in the subsoil, the evidence of clay movement downward in the soil, and the thickness of the solum.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Moran, W. J., Hayes, F. A., and Lovald, R. H. 1937. U.S. Dep. Agric. Soil Survey of Boyd County, Nebr. Ser. 1933, No. 9, 44 pp., illus.

(4) Snider, Luree. 1938. History of Boyd County, Nebraska. Lynch Herald, Lynch, Nebr. 99 pp.

(5) Souder, V. L. 1976. Physiography, geology, and water resources of Boyd County, Nebraska. Univ. Nebr., Inst. Agri. & Nat. Resour., Conserv. & Surv. Div. Nebr. Water Surv. Pap. 42, 113 pp.

(6) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(7) United States Department of Agriculture. 1975. Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth, soil. The total thickness of weathered soil material over bedrock or mixed sand and gravel. Following are the depth classes recognized in this survey:

	Inches
Deep	More than 40
Moderately deep	20 to 40
Shallow	10 to 20
Very shallow	0 to 10

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average

of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common*, and *many*; size—*fine, medium*, and *coarse*; and contrast—*faint, distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Organic matter, soil. The organic fraction of the soil. This includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. Organic-matter content is commonly defined as the organic material that accompanies the soil material when put through a 2-millimeter seive. Following are the ratings of organic-matter content recognized in this survey:

	Percent
Moderate	2.0 to 4.0
Moderately low	1.0 to 2.0
Low	0.5 to 1.0
Very low	Less than 0.5

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the saturated soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair*, and *poor*. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. Following are the slope classes recognized in this survey:

	Percent
Nearly level	0 to 2
Very gently sloping	1 to 3
Gently sloping or undulating	2 to 6
Strongly sloping or rolling	6 to 11
Moderately steep	11 to 17
Steep	17 to 30
Very steep	30 or more

Slow intake. The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams emerging from hills or mountains and spreading sediments onto the lowland as a series of adjacent alluvial fans.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Illustrations

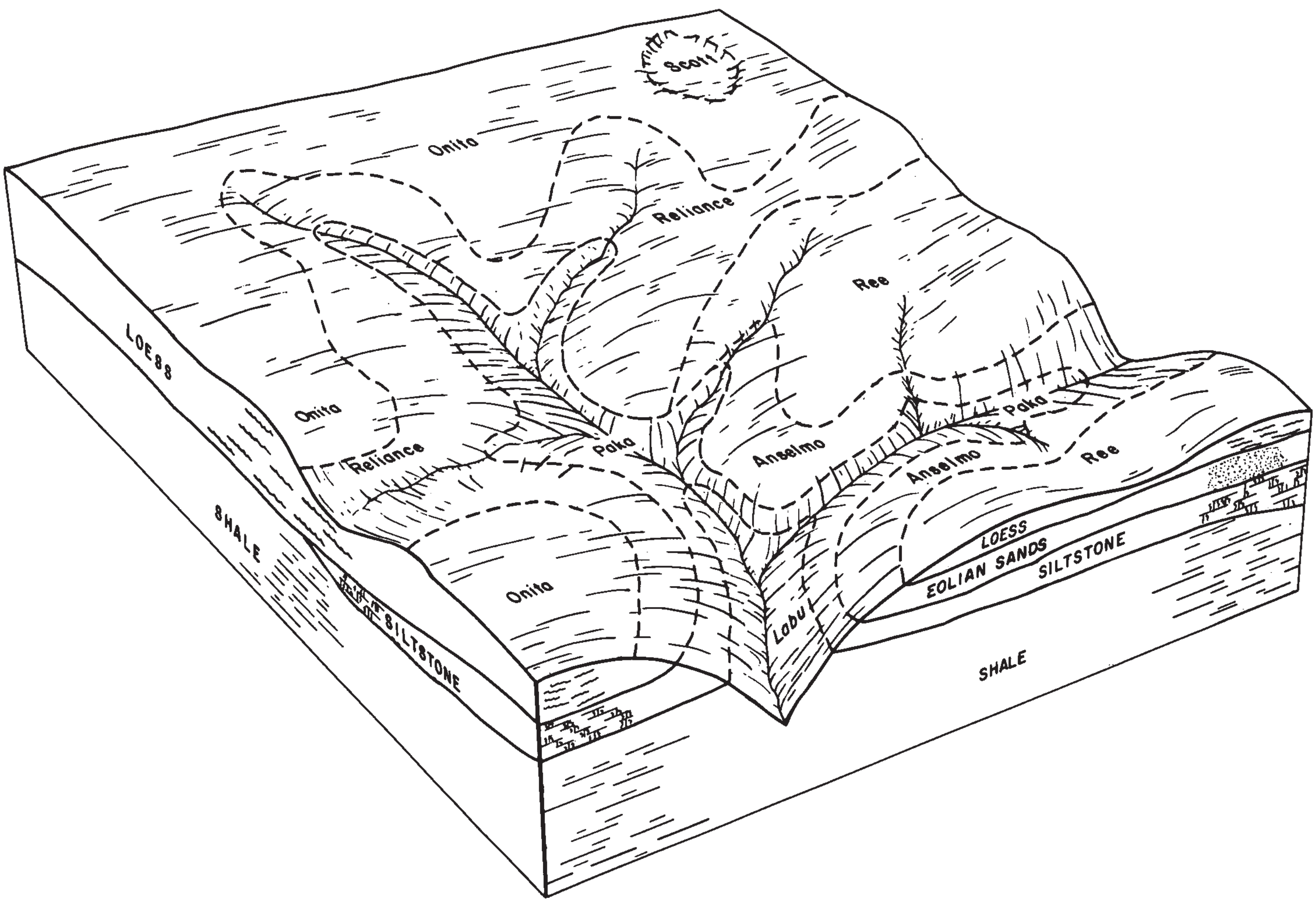

Figure 1.—Typical pattern of soils and parent material in Onita-Reliance-Ree association.

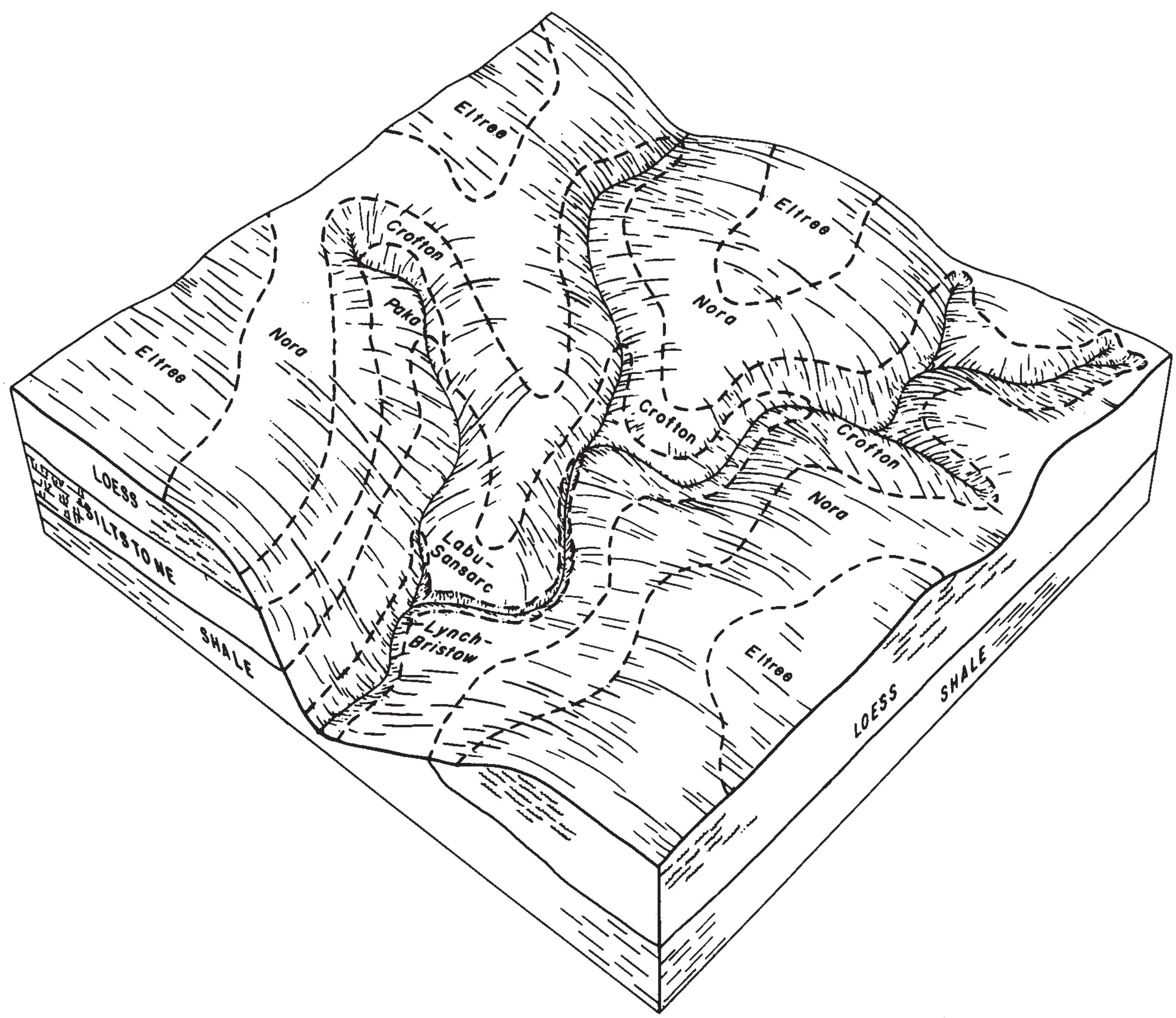

Figure 2.—Typical pattern of soils and parent material in Nora-Crofton-Eltree association.

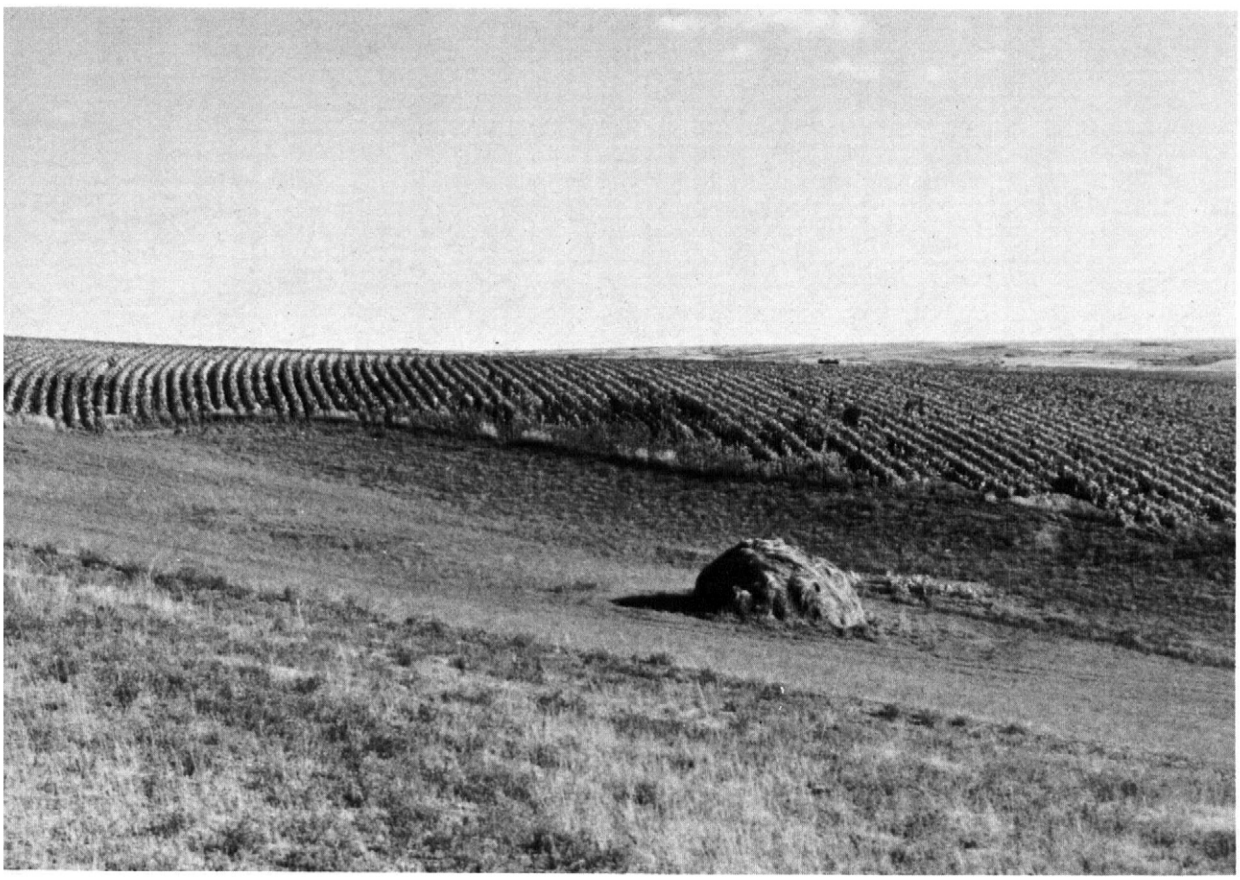

Figure 3.—Nora-Crofton-Eltree association. Nora soils are on the ridgetops, and Crofton soils are on the lower side slopes.

Figure 4.—Farmstead windbreaks, terraces, contour farming, and grassed waterways on Nora-Crofton-Eltree association.

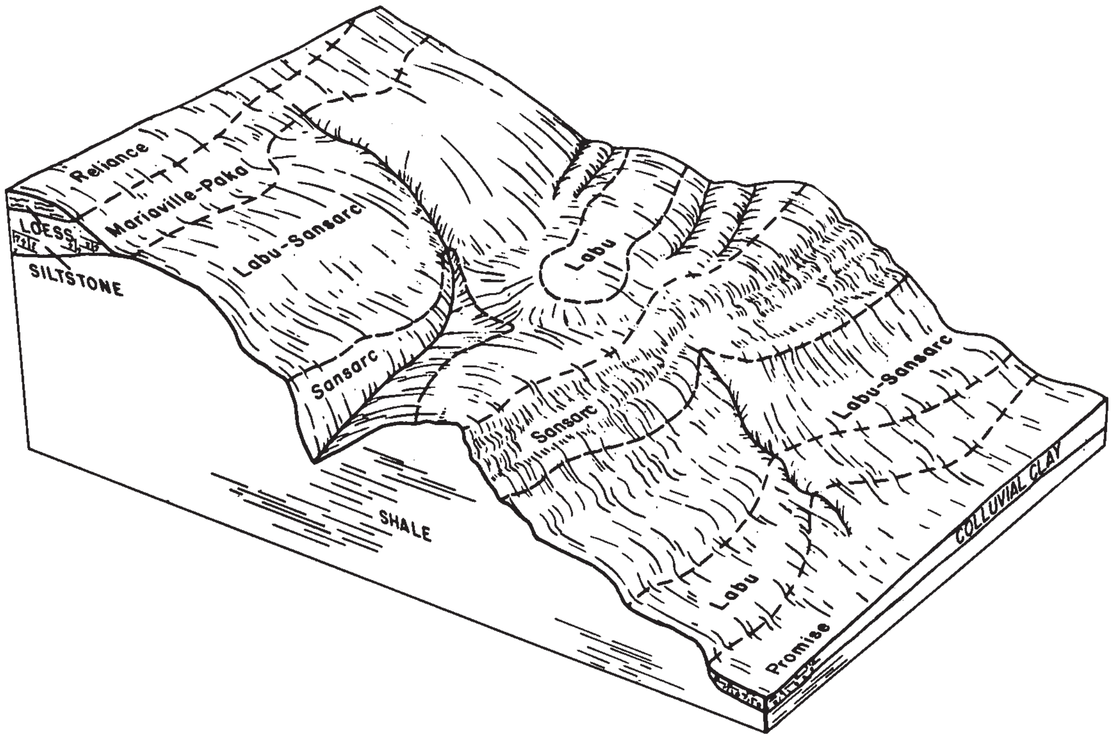

Figure 5.—Typical pattern of soils and parent material in Labu-Sansarc association.

Figure 6.—Landscape of Labu-Sansarc association. Labu soils are on the lower foot slopes and the smoother, more rounded knolls of the hillsides. Sansarc soils are on the steeper and higher slopes.

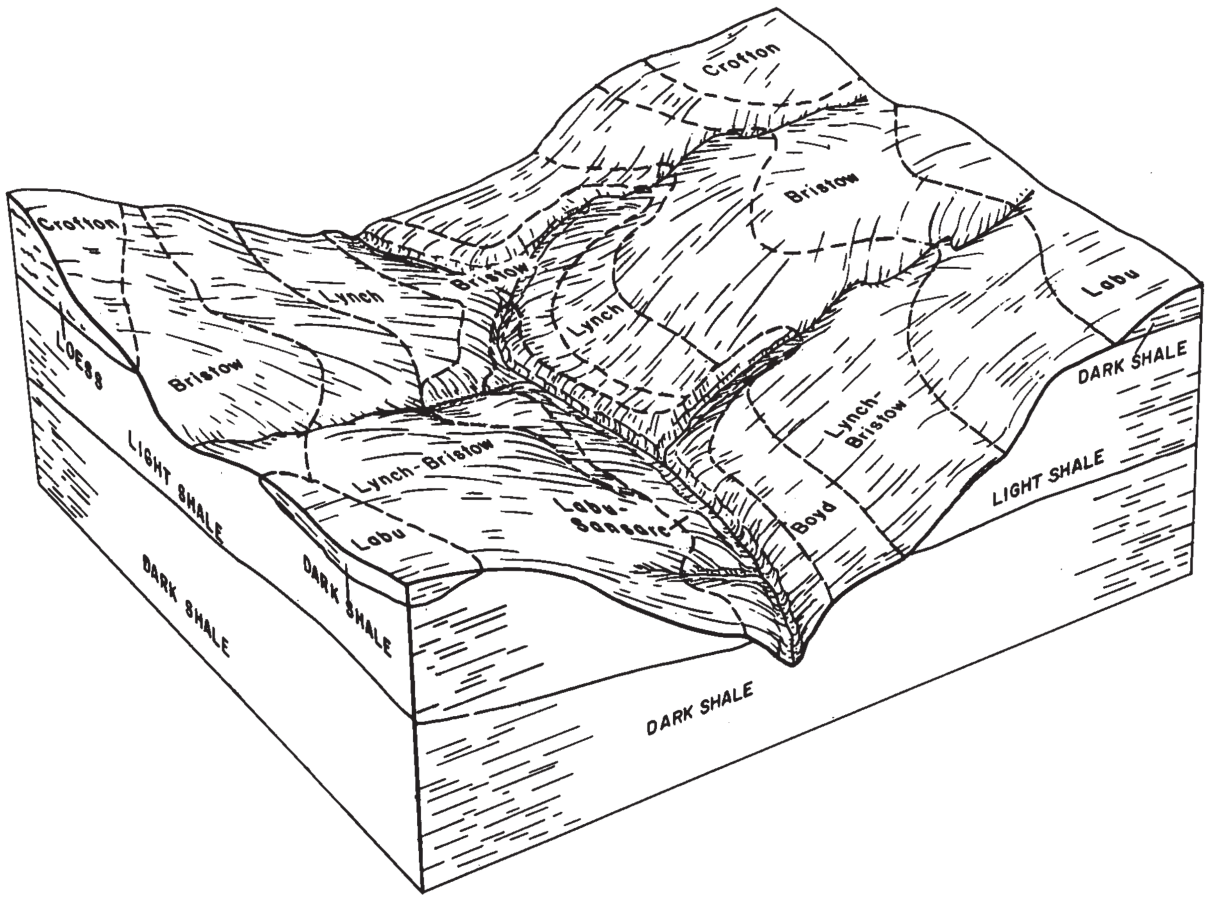

Figure 7.—Typical pattern of soils and parent material in Bristow-Lynch association.

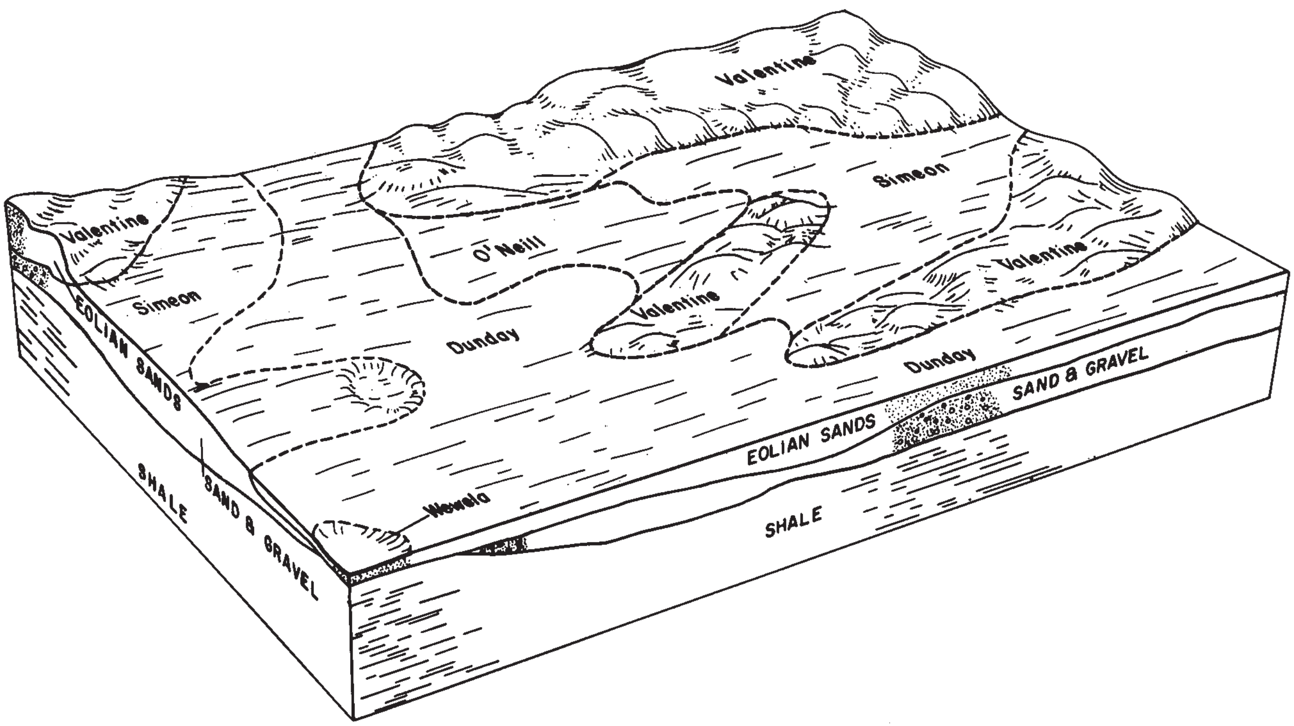

Figure 8.—Typical pattern of soils and parent material in Dunday-Valentine-Simeon association.

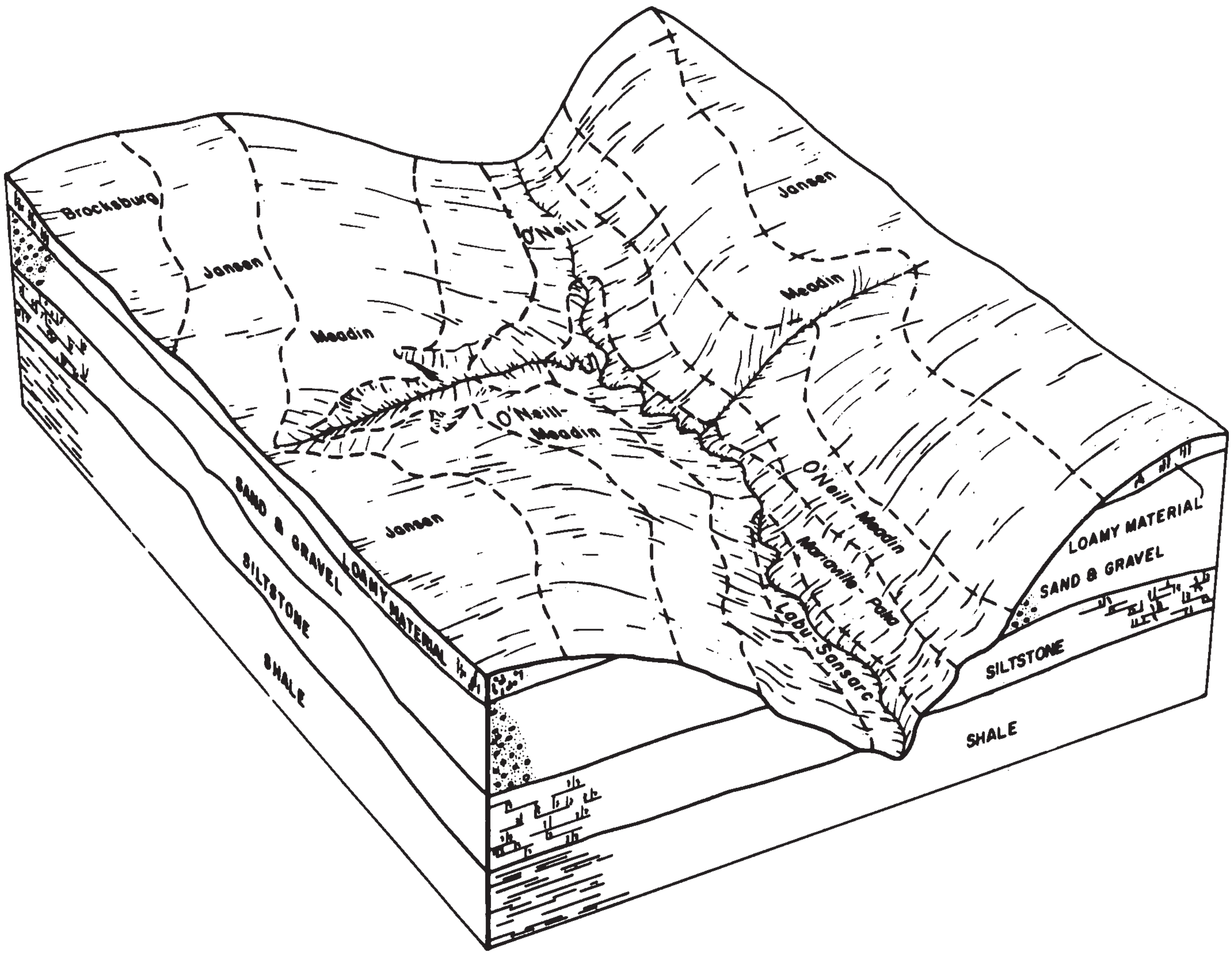

Figure 9.—Typical pattern of soils and parent material in Meadin-Jansen-O'Neill association.

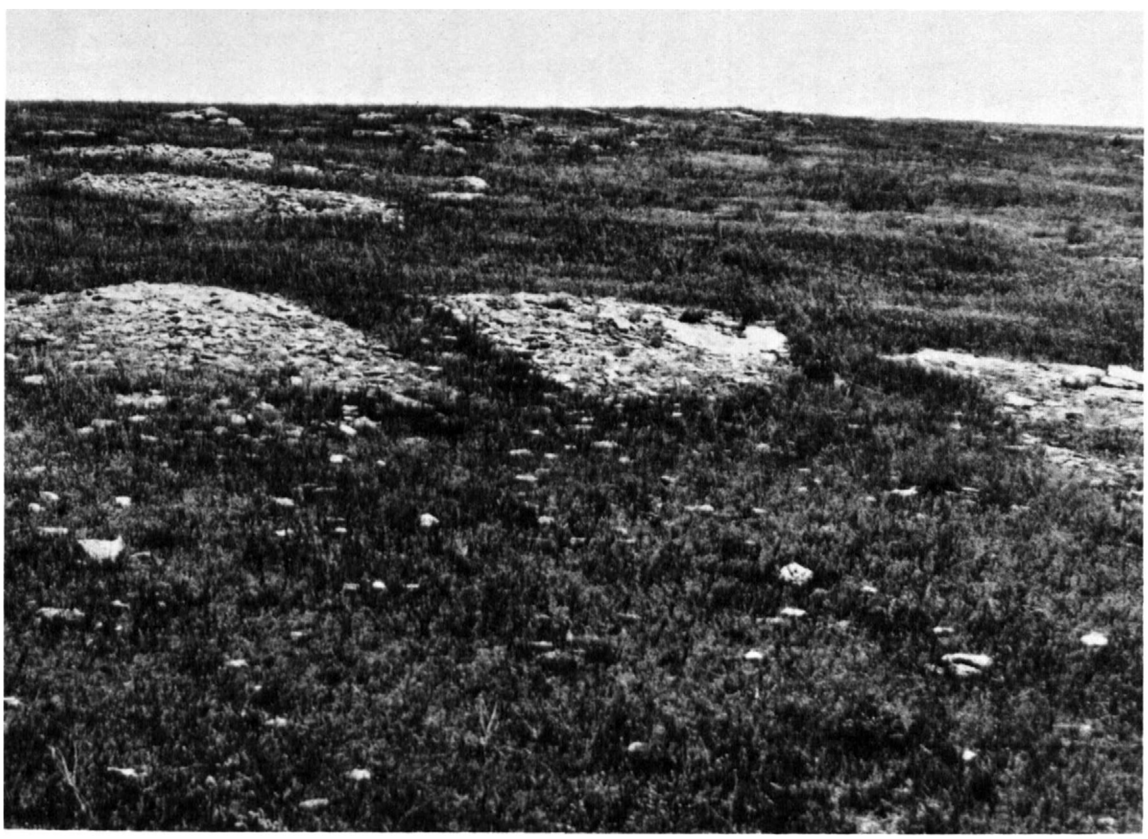

Figure 10.—Landscape of Anselmo-Rock outcrop complex, 11 to 20 percent slopes.

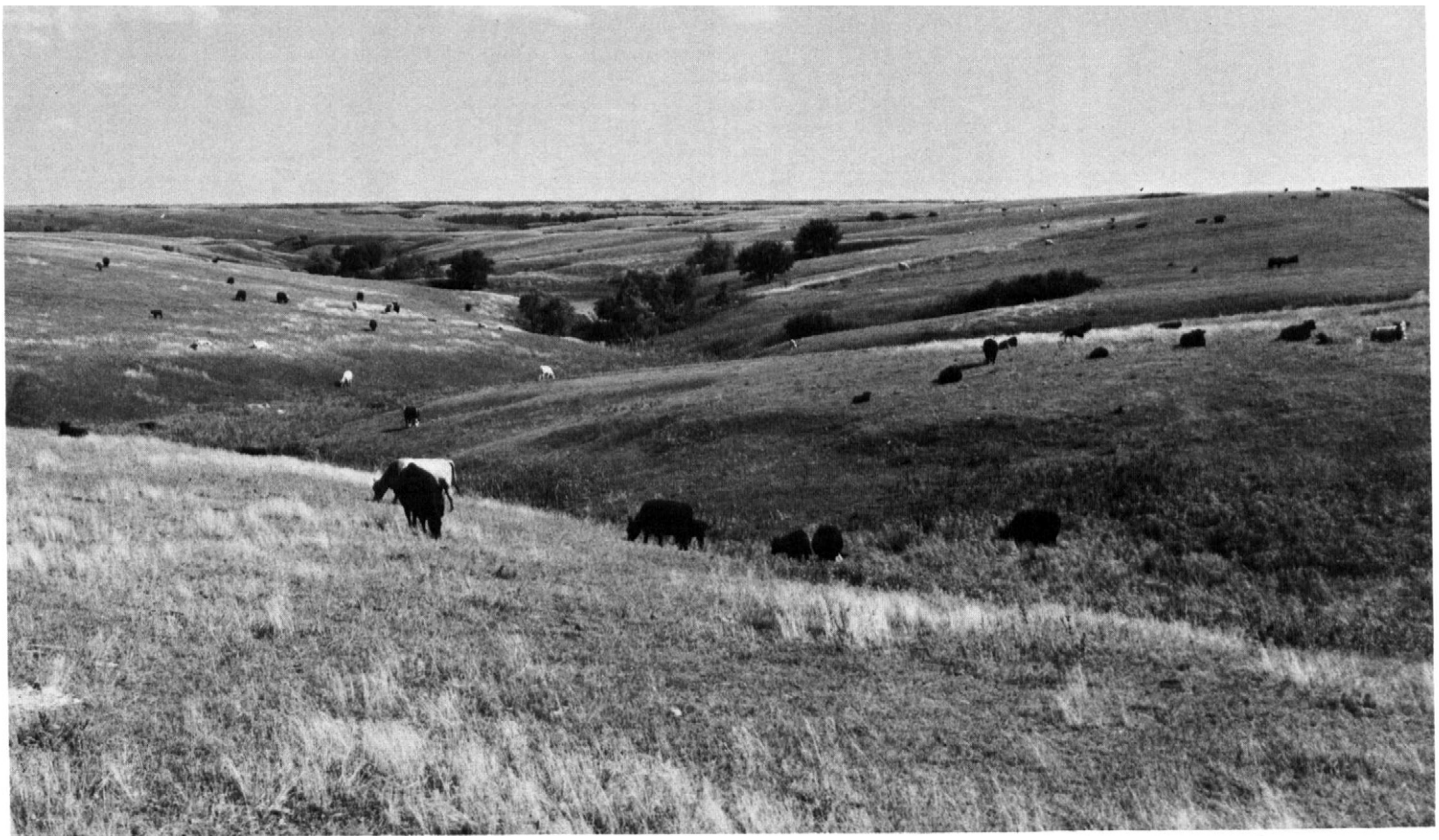

Figure 11.—Range in good condition on Labu-Sansarc silty clays, 11 to 30 percent slopes, as a result of proper stocking rates, uniform grazing distribution, deferred grazing, and a planned grazing system.

Figure 13.—Grain sorghum on Onita silt loam, 0 to 2 percent slopes.

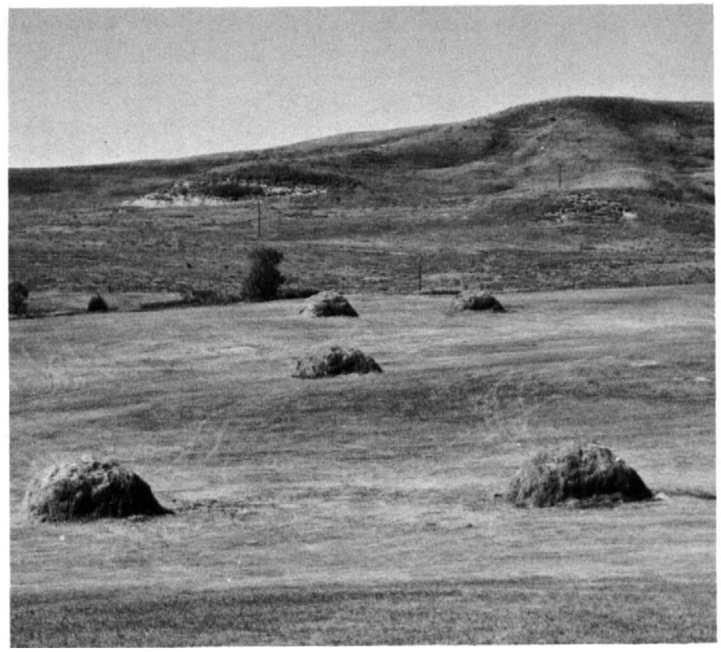

Figure 12.—Haying is common on Lynch silty clay, 6 to 11 percent slopes. Bristow silty clay, 20 to 40 percent slopes, is in the background.

Figure 14.—Inavale-Grigston-Cass association. Excellent plant cover and wildlife habitat along the Keya Paha River.

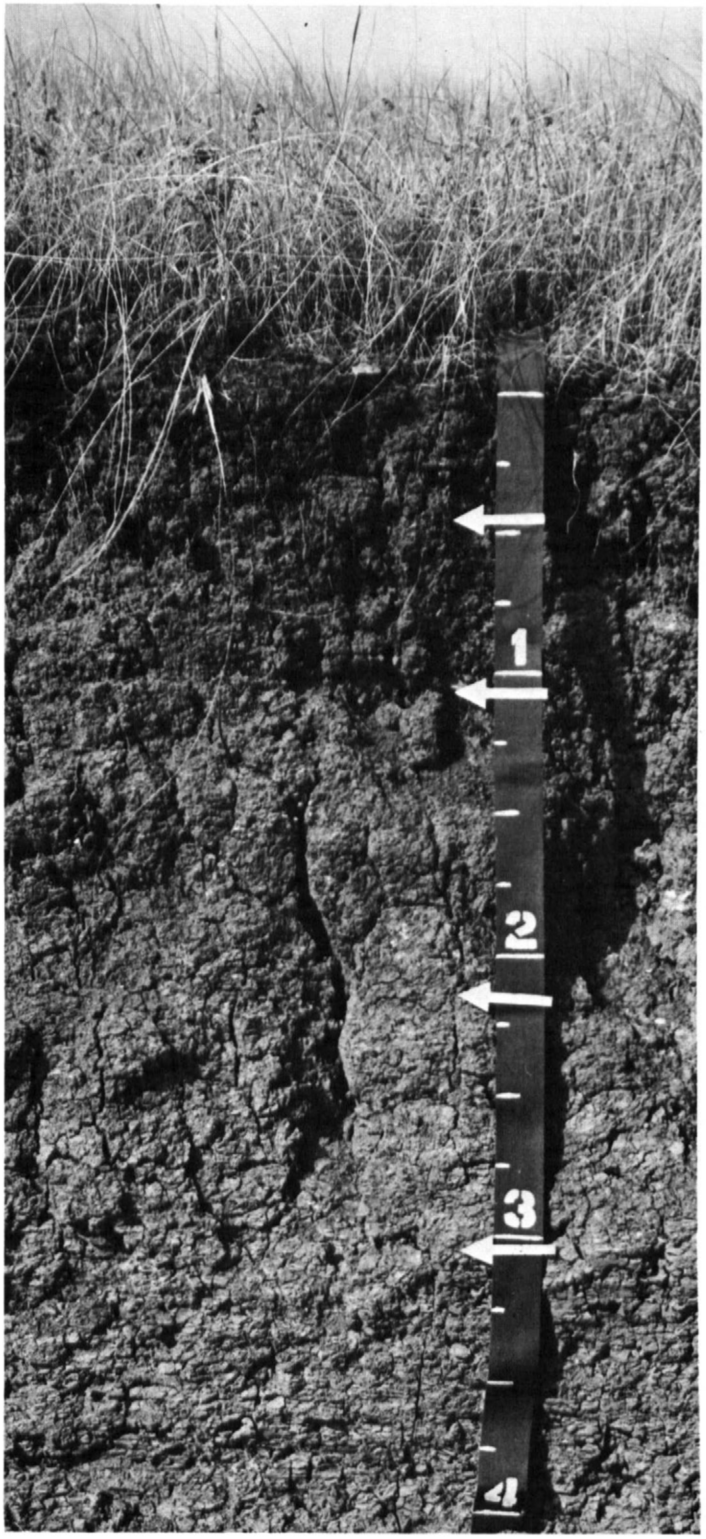

Figure 15.—Profile of Labu silty clay, 11 to 30 percent slopes. This soil formed in residuum of clay shale.

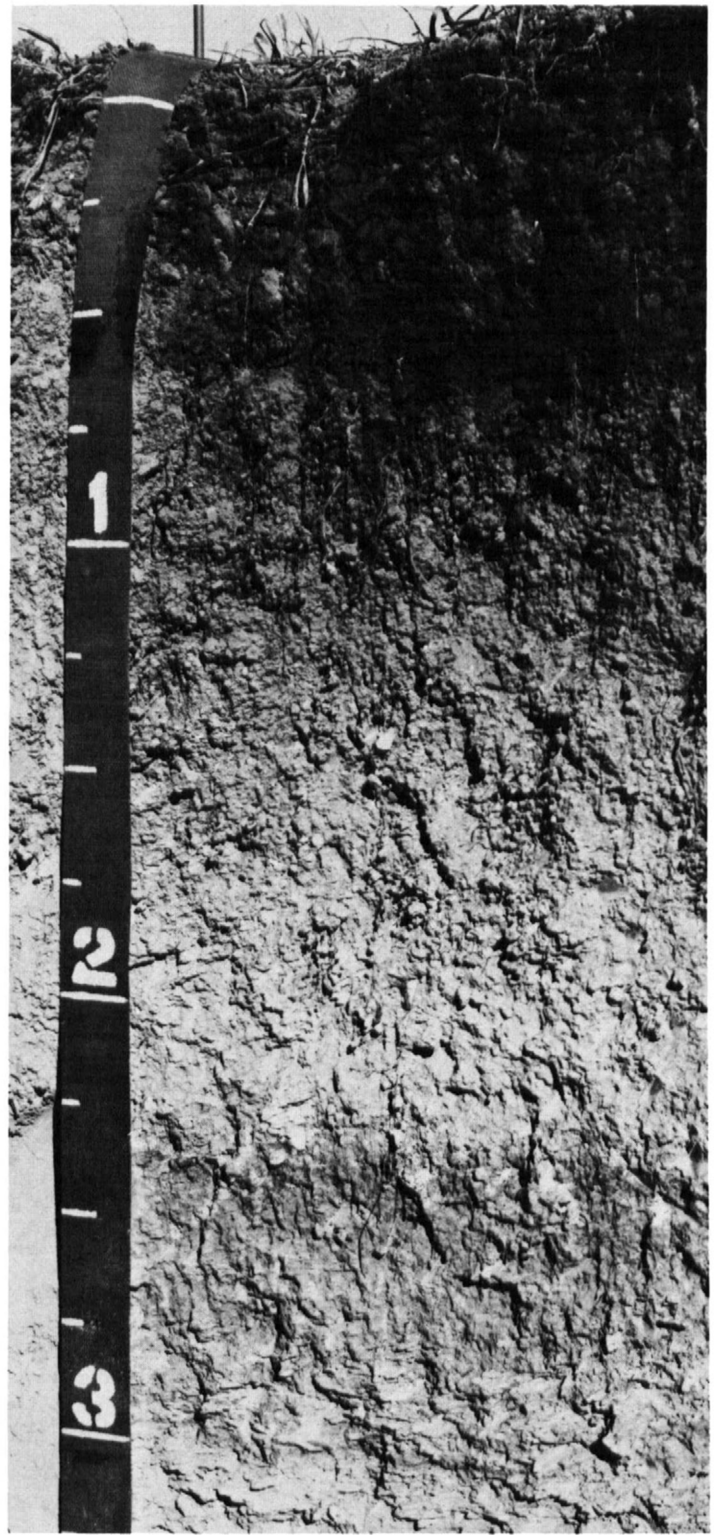

Figure 16.—Profile of Lynch silty clay, 6 to 11 percent slopes. Bedded shale is at a depth of 36 inches.

Figure 17.—Profile of Sansarc silty clay, 20 to 40 percent slopes. Bedded shale is at a depth of 17 inches.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with-- Maximum temperature equal to or higher than--	2 years in 10 will have at least 4 days with-- Minimum temperature equal to or lower than--	Average total	1 year in 10 will have-- Equal to or less than--	1 year in 10 will have-- Equal to or more than--	Days with 1 inch or more snow cover	Average depth of snow on days with snow cove
	^{o}F	^{o}F	^{o}F	^{o}F	In	In	In	Number	In
January---	31	8	52	-14	.4	.1	1.1	17	5
February--	37	14	60	-12	.7	.1	1.6	18	5
March-----	46	22	65	0	1.3	.2	2.6	13	6
April-----	62	35	83	20	2.3	.7	4.6	2	4
May-------	72	46	86	32	3.1	1.2	5.6	(1/)	4
June------	82	56	96	45	4.2	1.7	7.6	--	--
July------	89	62	100	50	3.2	.5	5.7	--	--
August----	87	61	98	49	2.7	1.1	4.7	--	--
September-	77	50	97	35	2.3	.5	3.8	--	--
October---	67	39	87	24	1.4	(2/)	3.3	(1/)	2
November--	48	25	72	7	.9	(2/)	1.8	5	4
December--	35	14	56	-9	.7	.1	1.3	14	5
Year---	61	36	3/104	4/-22	23.2	16.1	30.5	69	5

1/Less than 0.5 day.
2/Trace.
3/Average annual maximum.
4/Average annual minimum.

TABLE 2.--PROBABILITY OF LAST FREEZING TEMPERATURE IN SPRING AND FIRST IN FALL

Probability	Dates for given probability and temperature				
	16^{o} F or lower	20^{o} F or lower	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Spring:					
1 year in 10 later than--	April 14	April 22	May 3	May 12	May 24
2 years in 10 later than--	April 8	April 16	April 27	May 7	May 18
5 years in 10 later than--	March 29	April 6	April 17	April 26	May 8
Fall:					
1 year in 10 earlier than-	Oct. 23	Oct. 17	Oct. 9	Sept. 27	Sept. 17
2 years in 10 earlier than-	Oct. 29	Oct. 22	Oct. 14	Oct. 3	Sept. 22
5 years in 10 earlier than-	Nov. 9	Nov. 1	Oct. 24	Oct. 13	Oct. 1

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ab	Albaton silty clay, 0 to 2 percent slopes	660	0.2
AnC	Anselmo fine sandy loam, 2 to 6 percent slopes	5,770	1.6
AnD	Anselmo fine sandy loam, 6 to 11 percent slopes	7,280	2.1
AnF	Anselmo fine sandy loam, 11 to 20 percent slopes	5,720	1.6
ArF	Anselmo-Rock outcrop complex, 11 to 20 percent slopes	860	0.2
Ba	Barney silt loam, 0 to 2 percent slopes	2,020	0.6
Bd	Blake silty clay loam, 0 to 2 percent slopes	400	0.1
Be	Blendon fine sandy loam, 0 to 2 percent slopes	530	0.1
BeC	Blendon fine sandy loam, 2 to 6 percent slopes	1,110	0.3
BoD	Boyd silty clay, 6 to 11 percent slopes	3,240	0.9
BrG	Bristow silty clay, 20 to 40 percent slopes	15,650	4.5
Bs	Brocksburg fine sandy loam, 0 to 2 percent slopes	1,580	0.4
Bt	Brocksburg loam, 0 to 2 percent slopes	2,680	0.8
Cb	Cass fine sandy loam, 0 to 2 percent slopes	3,080	0.9
CrE2	Crofton silt loam, 11 to 15 percent slopes, eroded	2,760	0.8
DuB	Dunday loamy fine sand, 0 to 3 percent slopes	2,200	0.6
DuC	Dunday loamy fine sand, 3 to 6 percent slopes	5,010	1.4
DuD	Dunday loamy fine sand, 6 to 11 percent slopes	3,460	1.0
DxB	Dunday loamy fine sand, loamy substratum, 0 to 3 percent slopes	1,320	0.4
Et	Eltree silt loam, 0 to 2 percent slopes	2,100	0.6
Go	Grigston silt loam, 0 to 2 percent slopes	4,310	1.2
GrB	Grigston silt loam, channeled, 0 to 3 percent slopes	2,460	0.7
Ha	Hall silt loam, 0 to 2 percent slopes	2,390	0.7
He	Haynie silt loam, 0 to 2 percent slopes	1,110	0.3
IfD	Inavale fine sand, 3 to 11 percent slopes	840	0.2
IgB	Inavale fine sand, channeled, 0 to 3 percent slopes	2,350	0.7
IhB	Inavale loamy fine sand, 0 to 3 percent slopes	4,470	1.3
In	Inavale fine sandy loam, 0 to 2 percent slopes	1,660	0.5
Jn	Jansen loam, 0 to 2 percent slopes	890	0.2
JnC	Jansen loam, 2 to 6 percent slopes	2,610	0.7
JnD	Jansen loam, 6 to 11 percent slopes	2,130	0.6
LaD	Labu silty clay, 6 to 11 percent slopes	9,480	2.7
LcF	Labu-Sansarc silty clays, 11 to 30 percent slopes	51,150	14.6
Le	Leshara silt loam, 0 to 2 percent slopes	930	0.3
LsC	Lynch silty clay, 2 to 6 percent slopes	1,350	0.4
LsD	Lynch silty clay, 6 to 11 percent slopes	3,150	0.9
LyD	Lynch-Bristow silty clays, 6 to 11 percent slopes	4,350	1.2
LyF	Lynch-Bristow silty clays, 11 to 30 percent slopes	21,310	6.1
MaG	Mariaville-Paka loams, 15 to 40 percent slopes	8,990	2.5
MeE	Meadin sandy loam, 3 to 17 percent slopes	3,730	1.1
NoC	Nora silt loam, 2 to 6 percent slopes	3,660	1.0
NoD	Nora silt loam, 6 to 11 percent slopes	1,280	0.4
Oa	Onawa silty clay, 0 to 2 percent slopes	530	0.1
Oe	O'Neill fine sandy loam, 0 to 2 percent slopes	1,230	0.4
OeC	O'Neill fine sandy loam, 2 to 6 percent slopes	630	0.2
OfD	O'Neill-Meadin fine sandy loams, 3 to 9 percent slopes	2,180	0.6
On	Onita silt loam, 0 to 2 percent slopes	40,710	11.6
Or	Ord fine sandy loam, 0 to 2 percent slopes	1,250	0.4
PaC	Paka fine sandy loam, 2 to 6 percent slopes	790	0.2
Ph	Paka loam, 0 to 2 percent slopes	670	0.2
PhC	Paka loam, 2 to 6 percent slopes	1,940	0.6
PhD	Paka loam, 6 to 11 percent slopes	2,110	0.6
PoC	Promise silty clay, 2 to 6 percent slopes	2,320	0.7
RaC	Ree silt loam, 2 to 6 percent slopes	14,040	4.0
RaD	Ree silt loam, 6 to 11 percent slopes	5,900	1.7
RaE	Ree silt loam, 11 to 15 percent slopes	1,310	0.4
ReC	Reliance silt loam, 2 to 6 percent slopes	22,860	6.5
ReD	Reliance silt loam, 6 to 11 percent slopes	4,530	1.3
RfC	Reliance silty clay loam, 2 to 6 percent slopes	1,940	0.6
Rw	Riverwash	920	0.3
SaG	Sansarc silty clay, 20 to 40 percent slopes	9,070	2.6
Sc	Scott silt loam, 0 to 1 percent slopes	1,330	0.4
Sm	Simeon loamy sand, 0 to 2 percent slopes	3,100	0.9
SuC	Simeon-Valentine loamy sands, 0 to 6 percent slopes	2,900	0.8
SvF2	Simeon-Valentine complex, 3 to 30 percent slopes, eroded	8,530	2.4
VaE	Valentine fine sand, rolling	5,730	1.6
VbB	Valentine loamy sand, 0 to 3 percent slopes	2,820	0.8
Ve	Verdel silty clay, 0 to 2 percent slopes	2,040	0.6
WeC	Wewela fine sandy loam, 2 to 6 percent slopes	590	0.2
	Water	6,720	1.9
	Total	350,720	100.0

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Corn		Oats		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton
Ab: Albaton	80	110	50	---	65	100	3.0	4.5
AnC: Anselmo	41	130	40	---	45	110	2.0	5.0
AnD: Anselmo	35	---	35	---	40	---	1.3	4.0
AnF: Anselmo	---	---	---	---	---	---	---	3.0
ArF: Anselmo	---	---	---	---	---	---	---	---
Ba: Barney	---	---	---	---	---	---	---	---
Bd: Blake	85	140	65	---	80	120	3.0	6.0
Be: Blendon	50	145	45	75	55	120	2.0	5.5
BeC: Blendon	45	140	42	---	50	110	1.9	5.0
BoD: Boyd	26	---	30	---	40	---	1.0	---
BrG: Bristow	---	---	---	---	---	---	---	---
Bs: Brocksburg	30	130	30	---	40	110	1.3	4.5
Bt: Brocksburg	40	135	35	---	45	115	1.5	5.0
Cb: Cass	45	135	40	---	55	115	1.9	5.5
CrE2: Crofton	35	---	30	---	40	---	1.0	---
DuB: Dunday	30	125	30	---	35	100	1.2	4.5
DuC: Dunday	24	120	25	---	25	95	1.2	4.0
DuD: Dunday	---	---	---	---	---	---	---	---
DxB: Dunday	35	130	35	---	40	110	1.6	5.0
Et: Eltree	60	145	60	80	70	120	2.0	6.0
Go: Grigston	65	145	65	---	75	120	2.2	6.0

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Oats		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton
GrB------------------------ Grigston	---	---	---	---	---	---	---	---
Ha------------------------ Hall	60	145	60	80	70	120	2.2	6.0
He------------------------ Haynie	80	140	65	---	80	120	3.0	5.5
IfD------------------------ Inavale	---	---	---	---	---	---	---	---
IgB------------------------ Inavale	---	---	---	---	---	---	---	---
IhB------------------------ Inavale	30	110	30	---	35	100	1.5	4.0
In------------------------ Inavale	35	115	35	---	40	110	1.5	4.5
Jn------------------------ Jansen	35	135	30	---	40	110	1.5	5.0
JnC------------------------ Jansen	30	125	30	---	40	110	1.3	4.5
JnD------------------------ Jansen	30	---	25	---	31	---	0.6	4.0
LaD------------------------ Labu	24	---	25	---	38	---	1.0	---
LcF------------------------ Labu	---	---	---	---	---	---	---	---
Le------------------------ Leshara	60	145	50	---	75	120	2.5	5.0
LsC------------------------ Lynch	32	---	36	---	40	---	1.0	---
LsD------------------------ Lynch	25	---	28	---	30	---	0.8	---
LyD------------------------ Lynch	25	---	28	---	30	---	0.8	---
LyF------------------------ Lynch	---	---	---	---	---	---	---	---
MaG------------------------ Mariaville	---	---	---	---	---	---	---	---
MeE------------------------ Meadin	---	---	---	---	---	---	---	---
NoC------------------------ Nora	55	130	50	---	65	110	1.8	5.0
NoD------------------------ Nora	50	---	45	---	60	---	1.5	4.0
Oa------------------------ Onawa	80	110	55	---	75	110	3.0	4.5

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Oats		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton
Oe------------------------ O'Neill	30	130	30	---	35	105	1.0	4.0
OeC----------------------- O'Neill	25	110	28	---	30	100	0.8	3.5
OfD----------------------- O'Neill	---	---	---	---	---	---	---	---
On------------------------ Onita	55	145	60	80	70	125	2.0	5.5
Or------------------------ Ord	45	115	40	---	50	115	2.2	5.0
PaC----------------------- Paka	45	135	50	---	50	110	1.8	5.0
Ph------------------------ Paka	55	145	60	80	70	125	2.0	5.5
PhC----------------------- Paka	50	130	50	---	65	110	1.8	5.0
PhD----------------------- Paka	40	---	45	---	45	---	1.5	---
PoC----------------------- Promise	35	---	35	---	45	---	1.2	---
RaC----------------------- Ree	47	130	47	---	60	110	1.6	4.5
RaD----------------------- Ree	40	---	40	---	55	---	1.4	4.0
RaE----------------------- Ree	28	---	30	---	40	---	1.0	---
ReC----------------------- Reliance	50	130	50	---	65	115	1.8	5.0
ReD----------------------- Reliance	45	---	43	---	58	---	1.4	4.0
RfC----------------------- Reliance	45	125	45	---	60	110	1.6	4.8
Rw*. Riverwash								
SaG----------------------- Sansarc	---	---	---	---	---	---	---	---
Sc. Scott	---	---	---	---	---	---	---	---
Sm------------------------ Simeon	---	80	---	---	---	---	---	3.0
SuC----------------------- Simeon	---	90	---	---	---	---	---	3.1
SvF2---------------------- Simeon	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Oats		Grain sorghum		Alfalfa hay	
	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton
VaE------------------------ Valentine	---	---	---	---	---	---	---	---
VbB------------------------ Valentine	---	100	---	---	---	---	---	3.4
Ve------------------------- Verdel	45	115	45	---	55	110	1.6	5.0
WeC------------------------ Wewela	35	---	35	---	45	---	1.2	---

* See map unit description for the composition and behavior of the map unit.

TABLE 5.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses. Only potentially irrigable soils are assigned to irrigated subclasses. Miscellaneous areas are excluded. Dashes mean no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (Nonirrigated)	1,510	---	---	---	---
I (Irrigated)	47,380	---	---	---	---
II (Nonirrigated)	65,770	7,270	7,020	2,040	49,440
II (Irrigated)	16,240	3,610	7,020	5,610	---
III (Nonirrigated)	61,730	61,070	660	---	---
III (Irrigated)	67,840	67,180	660	---	---
IV (Nonirrigated)	59,890	58,560	1,330	---	---
IV (Irrigated)	43,110	37,110	---	6,000	---
V (Nonirrigated)	2,020	---	2,020	---	---
VI (Nonirrigated)	136,510	74,070	4,810	57,630	---
VII (Nonirrigated)	15,650	---	---	15,650	---
VIII (Nonirrigated)	920	---	920	---	---

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ab: Albaton	Clayey Overflow	Favorable	3,000	Big bluestem	15
		Normal	2,250	Western wheatgrass	15
		Unfavorable	1,500	Switchgrass	15
				Little bluestem	10
				Green needlegrass	10
				Indiangrass	5
				Canada wildrye	5
				Kentucky bluegrass	5
				Sedge	5
				Sideoats grama	5
AnC, AnD, AnF: Anselmo	Sandy	Favorable	3,250	Little bluestem	23
		Normal	2,600	Blue grama	18
		Unfavorable	1,350	Sand bluestem	13
				Needleandthread	12
				Prairie sandreed	8
				Buffalograss	5
				Western wheatgrass	5
ArF*:					
Anselmo	Sandy	Favorable	3,250	Little bluestem	23
		Normal	2,600	Blue grama	18
		Unfavorable	1,350	Sand bluestem	13
				Needleandthread	12
				Prairie sandreed	8
				Buffalograss	5
				Western wheatgrass	5
Rock outcrop.					
Ba: Barney	Wetland	Favorable	5,500	Prairie cordgrass	30
		Normal	5,000	Northern reedgrass	10
		Unfavorable	3,500	Sedge	10
				Rush	10
				Kentucky bluegrass	10
				Bluejoint reedgrass	5
				Switchgrass	5
				Common spikesedge	5
Bd: Blake	Clayey Overflow	Favorable	4,000	Big bluestem	25
		Normal	3,250	Little bluestem	15
		Unfavorable	2,500	Western wheatgrass	10
				Switchgrass	10
				Indiangrass	10
				Green needlegrass	5
				Kentucky bluegrass	5
				Sedge	5
				Sideoats grama	5
Be, BeC: Blendon	Sandy	Favorable	3,480	Little bluestem	35
		Normal	2,900	Prairie sandreed	15
		Unfavorable	2,030	Big bluestem	10
				Needleandthread	10
				Blue grama	10
				Porcupinegrass	5
				Leadplant	5
				Sedge	5
BoD: Boyd	Clayey	Favorable	2,400	Western wheatgrass	50
		Normal	2,000	Green needlegrass	25
		Unfavorable	1,000	Blue grama	10
				Sideoats grama	5
				Buffalograss	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
BrG: Bristow	Shallow Limy	Favorable	3,000	Little bluestem	43
		Normal	2,250	Big bluestem	15
		Unfavorable	1,250	Sideoats grama	10
				Indiangrass	5
				Needleandthread	5
				Sedge	5
				Leadplant	5
Bs: Brocksburg	Sandy	Favorable	3,000	Little bluestem	20
		Normal	2,250	Sand bluestem	15
		Unfavorable	1,250	Prairie sandreed	15
				Blue grama	10
				Needleandthread	10
				Switchgrass	5
				Sedge	5
				Leadplant	5
Bt: Brocksburg	Silty	Favorable	3,250	Big bluestem	35
		Normal	2,500	Little bluestem	18
		Unfavorable	1,750	Sideoats grama	10
				Indiangrass	6
				Blue grama	6
				Switchgrass	5
Cb: Cass	Sandy Lowland	Favorable	5,000	Sand bluestem	30
		Normal	4,000	Little bluestem	15
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Porcupinegrass	10
				Sedge	5
CrE2: Crofton	Limy Upland	Favorable	4,500	Little bluestem	40
		Normal	3,500	Big bluestem	25
		Unfavorable	2,000	Sideoats grama	5
				Leadplant	5
DuB, DuC, DuD, DxB: Dunday	Sandy	Favorable	3,000	Sand bluestem	25
		Normal	2,500	Little bluestem	20
		Unfavorable	1,750	Prairie sandreed	19
				Needleandthread	10
				Blue grama	7
				Switchgrass	5
				Sedge	5
Et: Eltree	Silty	Favorable	4,000	Big bluestem	35
		Normal	3,000	Little bluestem	18
		Unfavorable	1,000	Sideoats grama	10
				Indiangrass	6
				Blue grama	6
				Switchgrass	5
Go: Grigston	Silty Lowland	Favorable	4,000	Big bluestem	35
		Normal	3,500	Western wheatgrass	10
		Unfavorable	2,500	Switchgrass	15
				Little bluestem	10
				Sideoats grama	10
				Indiangrass	5
GrB: Grigston	Silty Overflow	Favorable	5,000	Big bluestem	30
		Normal	4,000	Western wheatgrass	15
		Unfavorable	3,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	5
				Indiangrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ha------------------ Hall	Silty Lowland------------------	Favorable	3,750	Little bluestem----------------	20
		Normal	3,000	Big bluestem-------------------	15
		Unfavorable	2,250	Western wheatgrass-------------	15
				Switchgrass--------------------	10
				Sideoats grama-----------------	7
				Indiangrass--------------------	5
				Sedge--------------------------	5
				Blue grama---------------------	5
				Needleandthread----------------	5
He------------------ Haynie	Silty Lowland------------------	Favorable	4,500	Big bluestem-------------------	30
		Normal	4,000	Little bluestem----------------	10
		Unfavorable	3,000	Western wheatgrass-------------	10
				Switchgrass--------------------	10
				Indiangrass--------------------	10
				Canada wildrye-----------------	5
				Porcupinegrass-----------------	5
				Tall dropseed------------------	5
				Sedge--------------------------	5
IfD----------------- Inavale	Sands--------------------------	Favorable	3,000	Sand bluestem------------------	18
		Normal	2,400	Prairie sandreed---------------	20
		Unfavorable	1,800	Little bluestem----------------	15
				Needleandthread----------------	8
				Switchgrass--------------------	8
				Sand lovegrass-----------------	10
				Blue grama---------------------	5
				Sand dropseed------------------	5
IgB----------------- Inavale	Sandy Lowland------------------	Favorable	4,440	Sand bluestem------------------	45
		Normal	3,700	Porcupinegrass-----------------	15
		Unfavorable	2,590	Little bluestem----------------	10
				Prairie sandreed---------------	10
				Switchgrass--------------------	5
				Sedge--------------------------	5
				Needleandthread----------------	5
IhB, In------------- Inavale	Sandy Lowland------------------	Favorable	3,360	Sand bluestem------------------	30
		Normal	2,800	Prairie sandreed---------------	20
		Unfavorable	1,460	Little bluestem----------------	15
				Needleandthread----------------	15
				Switchgrass--------------------	5
				Porcupinegrass-----------------	5
				Sedge--------------------------	5
Jn, JnC, JnD-------- Jansen	Silty--------------------------	Favorable	3,500	Little bluestem----------------	25
		Normal	2,500	Big bluestem-------------------	20
		Unfavorable	1,500	Sideoats grama-----------------	15
				Blue grama---------------------	10
				Buffalograss-------------------	5
				Sand dropseed------------------	5
				Western wheatgrass-------------	5
LaD----------------- Labu	Clayey-------------------------	Favorable	2,640	Western wheatgrass-------------	55
		Normal	2,200	Green needlegrass--------------	30
		Unfavorable	1,540	Sideoats grama-----------------	5
				Blue grama---------------------	5
LcF*:					
Labu---------------	Clayey-------------------------	Favorable	2,520	Western wheatgrass-------------	50
		Normal	2,100	Green needlegrass--------------	25
		Unfavorable	1,470	Blue grama---------------------	10
				Sideoats grama-----------------	5
				Buffalograss-------------------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
LcF*:					
Sansarc	Shallow Clay	Favorable	1,920	Little bluestem	35
		Normal	1,600	Sideoats grama	20
		Unfavorable	1,120	Blue grama	15
				Needleandthread	10
				Green needlegrass	5
				Sedge	5
Le	Subirrigated	Favorable	6,000	Big bluestem	25
Leshara		Normal	5,250	Little bluestem	10
		Unfavorable	4,000	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
				Slender wheatgrass	5
				Sedge	5
LsC, LsD	Limy Upland	Favorable	3,000	Big bluestem	25
Lynch		Normal	2,250	Little bluestem	15
		Unfavorable	1,250	Sideoats grama	10
				Needleandthread	10
				Green needlegrass	5
				Switchgrass	5
				Blue grama	5
				Sedge	5
				Western wheatgrass	5
LyD*, LyF*:					
Lynch	Limy Upland	Favorable	3,000	Big bluestem	25
		Normal	2,250	Little bluestem	15
		Unfavorable	1,250	Sideoats grama	10
				Needleandthread	10
				Green needlegrass	5
				Switchgrass	5
				Blue grama	5
				Sedge	5
				Western wheatgrass	5
Bristow	Shallow Limy	Favorable	3,000	Little bluestem	43
		Normal	2,250	Big bluestem	15
		Unfavorable	1,250	Sideoats grama	10
				Indiangrass	5
				Needleandthread	5
				Sedge	5
				Leadplant	5
MaG*:					
Mariaville	Shallow Limy	Favorable	2,750	Little bluestem	20
		Normal	2,250	Big bluestem	15
		Unfavorable	1,500	Sideoats grama	10
				Threadleaf sedge	10
				Needleandthread	10
				Blue grama	5
				Plains muhly	5
				Leadplant	5
				Fringed sagebrush	5
Paka	Silty	Favorable	3,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Needleandthread	10
				Switchgrass	5
				Indiangrass	5
				Blue grama	5
				Western wheatgrass	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
MeE: Meadin	Shallow to Gravel	Favorable	2,250	Blue grama	20
		Normal	1,750	Prairie sandreed	10
		Unfavorable	750	Sand bluestem	10
				Sand dropseed	10
				Clubmoss	10
				Needleandthread	8
				Sedge	6
				Little bluestem	5
				Switchgrass	5
NoC, NoD: Nora	Silty	Favorable	4,200	Little bluestem	25
		Normal	3,500	Big bluestem	20
		Unfavorable	2,450	Western wheatgrass	15
				Green needlegrass	10
				Needleandthread	10
				Sideoats grama	5
				Blue grama	5
				Sedge	5
Oa: Onawa	Clayey Overflow	Favorable	3,500	Big bluestem	20
		Normal	2,750	Western wheatgrass	15
		Unfavorable	2,000	Switchgrass	15
				Little bluestem	10
				Green needlegrass	10
				Indiangrass	5
				Kentucky bluegrass	5
				Sedge	5
				Sideoats grama	5
Oe, OeC: O'Neill	Sandy	Favorable	2,750	Sand bluestem	20
		Normal	2,000	Little bluestem	15
		Unfavorable	1,250	Prairie sandreed	15
				Blue grama	10
				Needleandthread	10
				Switchgrass	7
				Sand dropseed	5
				Gray sagewort	5
OfD*:					
O'Neill	Sandy	Favorable	2,750	Sand bluestem	20
		Normal	2,000	Little bluestem	15
		Unfavorable	1,250	Prairie sandreed	15
				Blue grama	10
				Needleandthread	10
				Switchgrass	7
				Sand dropseed	5
				Gray sagewort	5
Meadin	Shallow to Gravel	Favorable	2,250	Blue grama	20
		Normal	1,750	Prairie sandreed	10
		Unfavorable	750	Sand bluestem	10
				Sand dropseed	10
				Clubmoss	10
				Needleandthread	8
				Sedge	6
				Little bluestem	5
				Switchgrass	5
On: Onita	Silty	Favorable	4,950	Big bluestem	65
		Normal	4,500	Green needlegrass	10
		Unfavorable	3,150	Western wheatgrass	5
				Sideoats grama	5
				Leadplant	5
				Sedge	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Or: Ord	Subirrigated	Favorable	6,000	Big bluestem	30
		Normal	5,500	Indiangrass	12
		Unfavorable	5,000	Little bluestem	10
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	5
PaC: Paka	Sandy	Favorable	3,250	Little bluestem	25
		Normal	2,500	Needleandthread	20
		Unfavorable	1,500	Big bluestem	15
				Blue grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Sedge	5
Ph, PhC, PhD: Paka	Silty	Favorable	3,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Needleandthread	10
				Switchgrass	5
				Indiangrass	5
				Blue grama	5
				Western wheatgrass	5
				Sedge	5
PoC: Promise	Clayey	Favorable	2,400	Western wheatgrass	50
		Normal	2,000	Green needlegrass	25
		Unfavorable	1,000	Blue grama	10
				Sideoats grama	5
				Buffalograss	5
RaC, RaD, RaE: Ree	Silty	Favorable	3,480	Western wheatgrass	40
		Normal	2,900	Green needlegrass	20
		Unfavorable	2,030	Blue grama	15
				Needleandthread	10
				Sideoats grama	10
ReC, ReD, RfC: Reliance	Silty	Favorable	2,520	Western wheatgrass	30
		Normal	2,100	Green needlegrass	20
		Unfavorable	1,470	Needleandthread	15
				Blue grama	15
				Sideoats grama	10
				Sedge	5
SaG: Sansarc	Shallow Clay	Favorable	1,680	Little bluestem	30
		Normal	1,400	Sideoats grama	25
		Unfavorable	980	Blue grama	15
				Needleandthread	10
				Green needlegrass	5
				Sedge	5
Sm: Simeon	Shallow to Gravel	Favorable	2,500	Blue grama	20
		Normal	1,500	Sand bluestem	10
		Unfavorable	1,000	Prairie sandreed	10
				Needleandthread	10
				Hairy grama	5
				Little bluestem	5
				Sand dropseed	5
				Scribner panicum	5
				Sedge	5
				Leadplant	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
SuC*, SvF2*:					
Simeon	Shallow to Gravel	Favorable	2,500	Blue grama	20
		Normal	1,500	Sand bluestem	10
		Unfavorable	1,000	Prairie sandreed	10
				Needleandthread	10
				Hairy grama	5
				Little bluestem	5
				Sand dropseed	5
				Scribner panicum	5
				Sedge	5
				Leadplant	5
Valentine	Sands	Favorable	3,000	Prairie sandreed	20
		Normal	2,400	Sand bluestem	18
		Unfavorable	1,800	Little bluestem	15
				Sand lovegrass	10
				Switchgrass	8
				Needleandthread	8
				Blue grama	5
				Sand dropseed	5
VaE: Valentine	Sands	Favorable	3,000	Prairie sandreed	20
		Normal	2,400	Sand bluestem	18
		Unfavorable	1,800	Little bluestem	15
				Sand lovegrass	10
				Switchgrass	8
				Needleandthread	8
				Blue grama	5
				Sand dropseed	5
VbB: Valentine	Sandy	Favorable	3,000	Little bluestem	28
		Normal	2,200	Sand bluestem	15
		Unfavorable	1,200	Prairie sandreed	15
				Blue grama	10
				Sand dropseed	8
				Needleandthread	5
				Prairie junegrass	5
				Sedge	5
Ve: Verdel	Clayey	Favorable	4,000	Big bluestem	25
		Normal	3,250	Western wheatgrass	25
		Unfavorable	1,500	Little bluestem	5
				Switchgrass	5
				Sedge	5
				Tall dropseed	5
				Blue grama	5
				Kentucky bluegrass	5
				Green needlegrass	5
WeC: Wewela	Sandy	Favorable	3,000	Little bluestem	30
		Normal	2,500	Prairie sandreed	15
		Unfavorable	1,750	Needleandthread	10
				Sideoats grama	10
				Blue grama	10
				Big bluestem	5
				Western wheatgrass	5
				Switchgrass	5

* See map unit description for the composition and behavior of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Absence of an entry means soil does not normally grow trees of this height class]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ab----------------- Albaton	American plum, redosier dogwood.	Autumn-olive, common choke- cherry.	Eastern redcedar, Austrian pine, Scotch pine, Black Hills spruce.	American sycamore, silver maple, green ash.	Eastern cottonwood.
AnC, AnD, AnF----- Anselmo	Skunkbush sumac, Amur honeysuckle, common choke- cherry, Peking cotoneaster, lilac.	---	Eastern redcedar, green ash, honey- locust.	Ponderosa pine, Austrian pine, Scotch pine.	Eastern cottonwood.
ArF*:					
Anselmo-----------	Skunkbush sumac, Amur honeysuckle, common chokecherry, Peking cotoneaster, lilac.	---	Eastern redcedar, green ash, honey- locust.	Ponderosa pine, Austrian pine, Scotch pine.	Eastern cottonwood.
Rock outcrop.					
Ba----------------- Barney	Redosier dogwood--	---	Golden willow-----	---	Eastern cottonwood.
Bd----------------- Blake	Peking cotoneaster	Autumn-olive, Amur honeysuckle.	Blue spruce, eastern redcedar.	Hackberry, green ash, Austrian pine, ponderosa pine, Scotch pine, honeylocust.	Eastern cottonwood.
Be, BeC----------- Blendon	Silver buffaloberry, Peking cotoneaster, lilac, American plum.	Common choke- cherry.	Green ash, eastern redcedar.	Ponderosa pine, Austrian pine, Scotch pine.	Eastern cottonwood.
BoD---------------- Boyd	Skunkbush sumac---	Siberian crabapple, Siberian pea- shrub.	Russian-olive, eastern redcedar, Rocky Mt. juniper.	---	---
BrG. Bristow					
Bs, Bt------------ Brocksburg	Skunkbush sumac, Siberian peashrub.	Russian-olive, eastern redcedar.	Ponderosa pine, Austrian pine, Scotch pine.	---	---
Cb----------------- Cass	Skunkbush sumac, Peking cotoneaster.	Autumn-olive, common choke- cherry, Amur honeysuckle.	Hackberry---------	Austrian pine, green ash, honeylocust, Scotch pine, ponderosa pine.	Eastern cottonwood.
CrE2--------------- Crofton	Skunkbush sumac, Siberian peashrub.	Russian-olive-----	Eastern redcedar, ponderosa pine, Austrian pine, Scotch pine.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
DuB, DuC, DuD, DxB: Dunday	Skunkbush sumac, Amur honeysuckle, common chokecherry, Peking cotoneaster.	---	Eastern redcedar, green ash, honeylocust, hackberry.	Ponderosa pine, Austrian pine, Scotch pine.	Eastern cottonwood.
Et: Eltree	Skunkbush sumac, Peking cotoneaster, lilac.	Amur honeysuckle, autumn-olive, Amur maple.	Eastern redcedar, hackberry, green ash.	Ponderosa pine, Austrian pine, Scotch pine, honeylocust.	---
Go: Grigston	Peking cotoneaster.	Autumn-olive, American plum, Amur honeysuckle.	Eastern redcedar, blue spruce.	Green ash, honeylocust, hackberry, ponderosa pine, Scotch pine, Austrian pine.	Eastern cottonwood.
GrB. Grigston					
Ha: Hall	Peking cotoneaster, skunkbush sumac.	Autumn-olive, common chokecherry, Amur honeysuckle.	Eastern redcedar, green ash, common hackberry.	Ponderosa pine, Austrian pine, Scotch pine, honeylocust.	---
He: Haynie	Peking cotoneaster.	Autumn-olive, Amur honeysuckle.	Eastern redcedar, blue spruce.	Green ash, honeylocust, ponderosa pine, Scotch pine, Austrian pine.	Eastern cottonwood.
IfD, IhB, In: Inavale	Skunkbush sumac, Peking cotoneaster.	Autumn-olive, common chokecherry, Amur honeysuckle.	Eastern redcedar, hackberry.	Austrian pine, Scotch pine, ponderosa pine, green ash, honeylocust.	Eastern cottonwood.
IgB. Inavale					
Jn, JnC, JnD: Jansen	Skunkbush sumac, Siberian peashrub.	Eastern redcedar, Russian-olive.	Scotch pine, Austrian pine, ponderosa pine.	---	---
LaD: Labu	Siberian peashrub, silver buffaloberry, lilac, skunkbush sumac.	Rocky Mt. juniper, Russian-olive, eastern redcedar.	---	---	---
LcF*: Labu.					
Sansarc.					
Le: Leshara	American plum, redosier dogwood.	Autumn-olive, common chokecherry.	Eastern redcedar, Black Hills spruce.	Austrian pine, Scotch pine, green ash, honeylocust, silver maple.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
LsC, LsD: Lynch	Skunkbush sumac	Eastern redcedar, Rocky Mt. juniper, Russian-olive.	Siberian elm	---	---
LyD*:					
Lynch	Skunkbush sumac, Siberian peashrub.	Eastern redcedar, Rocky Mt. juniper, Russian-olive.	---	---	---
Bristow.					
LyF*:					
Lynch.					
Bristow.					
MaG*:					
Mariaville.					
Paka.					
MeE. Meadin					
NoC, NoD: Nora	Lilac, Peking cotoneaster, skunkbush sumac.	Common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Green ash, hackberry, eastern redcedar.	Austrian pine, ponderosa pine, Scotch pine.	---
Oa: Onawa	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Black Hills spruce, eastern redcedar.	Austrian pine, silver maple, green ash, honeylocust, Scotch pine.	Eastern cottonwood.
Oe, OeC: O'Neill	Skunkbush sumac, Siberian peashrub.	Russian-olive, eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine.	---	---
OfD*:					
O'Neill	Skunkbush sumac, Siberian peashrub.	Russian-olive, eastern redcedar.	Austrian pine, Scotch pine, ponderosa pine.	---	---
Meadin.					
On: Onita	Peking cotoneaster, skunkbush sumac, lilac.	Common chokecherry, Siberian peashrub, American plum.	Green ash, hackberry, eastern redcedar.	Ponderosa pine, Austrian pine, Scotch pine.	---
Or: Ord	Redosier dogwood, American plum.	Autumn-olive, common chokecherry.	Eastern redcedar, Black Hills spruce.	Green ash, Austrian pine, Scotch pine, honeylocust, silver maple.	Eastern cottonwood.
PaC, Ph, PhC, PhD: Paka	Peking cotoneaster, skunkbush sumac, lilac.	Amur maple, American plum, silver buffaloberry, common chokecherry.	Eastern redcedar, green ash, hackberry.	Ponderosa pine, honeylocust, Austrian pine, Scotch pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
PoC: Promise	American plum, silver buffaloberry, Siberian peashrub, lilac, skunkbush sumac.	Ponderosa pine, Russian-olive, eastern redcedar, common chokecherry, Rocky Mt. juniper.	Green ash, common hackberry.	---	---
RaC, RaD, RaE: Ree	Lilac, Peking cotoneaster.	Common chokecherry, American plum, silver buffaloberry.	Ponderosa pine, green ash, common hackberry, honeylocust, eastern redcedar, Austrian pine.	Blue spruce	---
ReC, ReD, RfC: Reliance	Lilac, Peking cotoneaster.	Common chokecherry, American plum, silver buffaloberry.	Ponderosa pine, green ash, common hackberry, honeylocust, eastern redcedar, Austrian pine.	Blue spruce	---
Rw*. Riverwash					
SaG. Sansarc					
Sc. Scott					
Sm. Simeon					
SuC*: Simeon.					
Valentine	---	---	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine.	---	---
SvF2*: Simeon.					
Valentine.					
VaE: Valentine	---	---	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine.	---	---
VbB: Valentine	---	---	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine.	---	---
Ve: Verdel	Skunkbush sumac, Siberian peashrub.	Eastern redcedar, Rocky Mt. juniper, Russian-olive, common chokecherry.	Siberian elm, green ash, common hackberry.	---	---
WeC: Wewela	Peking cotoneaster, lilac.	Siberian crabapple, common chokecherry, American plum, silver buffaloberry, Siberian peashrub.	Green ash, common hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	---

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ab------------ Albaton	Severe: wetness, too clayey, floods.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.
AnC------------ Anselmo	Slight----------	Slight----------	Slight----------	Moderate: slope.	Moderate: frost action, low strength.
AnD------------ Anselmo	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.
AnF------------ Anselmo	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
ArF*:					
Anselmo---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
Ba------------ Barney	Severe: wetness, cutbanks cave, floods.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Bd------------ Blake	Severe: wetness, floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Severe: low strength, floods, frost action.
Be------------ Blendon	Severe: cutbanks cave.	Slight----------	Slight----------	Slight----------	Moderate: low strength, frost action.
BeC------------ Blendon	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Moderate: low strength, frost action.
BoD------------ Boyd	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
BrG------------ Bristow	Severe: too clayey, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.
Bs, Bt---------- Brocksburg	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.
Cb------------ Cass	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
CrE2------------ Crofton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
DuB: Dunday	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
DuC: Dunday	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
DuD: Dunday	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
DxB: Dunday	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Et: Eltree	Slight	Slight	Slight	Slight	Moderate: frost action, low strength.
Go: Grigston	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
GrB: Grigston	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Ha: Hall	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
He: Haynie	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, frost action.
IfD: Inavale	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
IgB, IhB, In: Inavale	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Jn: Jansen	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.
JnC: Jansen	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.
JnD: Jansen	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: shrink-swell, slope.
LaD: Labu	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
LcF*:					
Labu	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Sansarc	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Le: Leshara	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods, frost action.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
LsC: Lynch	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
LsD: Lynch	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength.
LyD*:					
Lynch	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength.
Bristow	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell.
LyF*:					
Lynch	Severe: too clayey, slope.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength, slope.
Bristow	Severe: too clayey, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.
MaG*:					
Mariaville	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
Paka	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
MeE: Meadin	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
NoC: Nora	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
NoD: Nora	Moderate: slope.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: slope.	Severe: frost action, low strength.
Oa: Onawa	Severe: wetness, too clayey, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, shrink-swell.
Oe: O'Neill	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action, low strength.
OeC: O'Neill	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.
OfD*:					
O'Neill	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
OfD*:					
Meadin	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
On: Onita	Slight	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Or: Ord	Severe: cutbanks cave, wetness, floods.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: frost action, floods.
PaC, Ph, PhC: Paka	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
PhD: Paka	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
PoC: Promise	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
RaC: Ree	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, frost action.
RaD, RaE: Ree	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, slope.	Severe: slope.	Moderate: shrink-swell, low strength, slope.
ReC: Reliance	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
ReD: Reliance	Moderate: slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope, shrink-swell, low strength.	Severe: low strength, shrink-swell.
RfC: Reliance	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Rw*. Riverwash					
SaG: Sansarc	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Sc: Scott	Severe: floods, too clayey, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.
Sm: Simeon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
SuC*:					
Simeon	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
SuC*:					
Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
SvF2*:					
Simeon	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valentine	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VaE Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
VbB Valentine	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Ve Verdel	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
WeC Wewela	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ab------------------ Albaton	Severe: percs slowly, wetness, floods.	Slight-----------	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
AnC----------------- Anselmo	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
AnD----------------- Anselmo	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
AnF----------------- Anselmo	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.
ArF*:					
Anselmo------------	Severe: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage, slope.	Poor: slope.
Rock outcrop.					
Ba------------------ Barney	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: thin layer, wetness.
Bd------------------ Blake	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Good.
Be, BeC------------- Blendon	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
BoD----------------- Boyd	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey, area reclaim.
BrG----------------- Bristow	Severe: depth to rock, percs slowly, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope.	Poor: too clayey, area reclaim, slope.
Bs, Bt-------------- Brocksburg	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Cb------------------ Cass	Severe: floods.	Severe: seepage.	Severe: floods, seepage.	Severe: seepage, floods.	Good.
CrE2---------------- Crofton	Moderate: slope.	Severe: slope.	Slight-----------	Moderate: slope.	Fair: slope.
DuB, DuC------------ Dunday	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy.
DuD----------------- Dunday	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
DxB: Dunday	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy.
Et: Eltree	Slight	Moderate: seepage.	Slight	Slight	Good.
Go: Grigston	Moderate: floods.	Moderate: seepage.	Moderate: floods.	Moderate: floods.	Good.
GrB: Grigston	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Ha: Hall	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Good.
He: Haynie	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
IfD: Inavale	Moderate: floods.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
IgB, IhB, In: Inavale	Severe: floods.	Severe: floods, seepage.	Severe: seepage, too sandy, floods.	Severe: seepage, floods.	Poor: too sandy.
Jn, JnC: Jansen	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: thin layer.
JnD: Jansen	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: thin layer, slope.
LaD: Labu	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey, area reclaim.
LcF*:					
Labu	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey, area reclaim.
Sansarc	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
Le: Leshara	Severe: floods, wetness.	Severe: wetness, floods, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness.	Good.
LsC: Lynch	Severe: percs slowly, depth to rock.	Moderate: depth to rock, slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey.
LsD: Lynch	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey.
LyD*:					
Lynch	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
LyD*:					
Bristow	Severe: depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Poor: too clayey, area reclaim.
LyF*:					
Lynch	Severe: percs slowly, depth to rock, slope.	Severe: slope.	Severe: too clayey, depth to rock.	Severe: slope.	Poor: too clayey, slope.
Bristow	Severe: depth to rock, percs slowly, slope.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: too clayey, area reclaim, slope.
MaG*:					
Mariaville	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: thin layer, slope.
Paka	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
MeE Meadin	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
NoC Nora	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
NoD Nora	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Oa Onawa	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: too clayey.
Oe, OeC O'Neill	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: thin layer.
OfD*:					
O'Neill	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: thin layer.
Meadin	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
On Onita	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Or Ord	Severe: wetness, floods.	Severe: wetness, floods, seepage.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Good.
PaC Paka	Moderate: percs slowly, depth to rock.	Moderate: seepage, slope.	Severe: depth to rock.	Slight	Good.
Ph Paka	Moderate: percs slowly, depth to rock.	Moderate: seepage.	Severe: depth to rock.	Slight	Good.

See footnote at end of table..

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PhC----------------- Paka	Moderate: percs slowly, depth to rock.	Moderate: seepage, slope.	Severe: depth to rock.	Slight-----------	Good.
PhD----------------- Paka	Moderate: slope, percs slowly, depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Fair: slope.
PoC----------------- Promise	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
RaC----------------- Ree	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
RaD, RaE------------ Ree	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
ReC----------------- Reliance	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
ReD----------------- Reliance	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
RfC----------------- Reliance	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Rw*. Riverwash					
SaG----------------- Sansarc	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
Sc------------------ Scott	Severe: floods, percs slowly, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, too clayey.
Sm------------------ Simeon	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
SuC*:					
Simeon--------------	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Valentine-----------	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
SvF2*:					
Simeon--------------	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: slope, too sandy.
Valentine-----------	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VaE------------------ Valentine	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
VbB------------------ Valentine	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Ve------------------- Verdel	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
WeC------------------ Wewela	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight-----------	Poor: thin layer, area reclaim.

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ab: Albaton	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
AnC: Anselmo	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
AnD: Anselmo	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
AnF: Anselmo	Fair: slope, low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: slope.
ArF*:				
Anselmo	Fair: slope, low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: slope.
Rock outcrop.				
Ba: Barney	Poor: wetness.	Good	Good	Poor: wetness.
Bd: Blake	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Be, BeC: Blendon	Good	Fair: excess fines.	Unsuited: excess fines.	Good.
BoD: Boyd	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
BrG: Bristow	Poor: shrink-swell, thin layer, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, area reclaim, too clayey.
Bs, Bt: Brocksburg	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
Cb: Cass	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
CrE2: Crofton	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
DuB, DuC: Dunday	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
DuD: Dunday	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
DxB: Dunday	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Et: Eltree	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Go, GrB: Grigston	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ha: Hall	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
He: Haynie	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
IfD, IgB: Inavale	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
IhB: Inavale	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
In: Inavale	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Jn, JnC: Jansen	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
JnD: Jansen	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer, slope.
LaD: Labu	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
LcF*:				
Labu	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey.
Sansarc	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey, area reclaim.
Le: Leshara	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
LsC, LsD: Lynch	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
LyD*:				
Lynch	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Bristow	Poor: shrink-swell, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, too clayey.
LyF*:				
Lynch	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
LyF*:				
Bristow	Poor: shrink-swell, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, area reclaim, too clayey.
MaG*:				
Mariaville	Poor: thin layer, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Paka	Poor: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
MeE Meadin	Good	Fair: excess fines.	Fair: excess fines.	Poor: thin layer, area reclaim.
NoC Nora	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
NoD Nora	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Oa Onawa	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Oe, OeC O'Neill	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
OfD*:				
O'Neill	Good	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
Meadin	Good	Fair: excess fines.	Fair: excess fines.	Poor: thin layer, area reclaim.
On Onita	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Or Ord	Poor: wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
PaC, Ph, PhC Paka	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
PhD Paka	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
PoC Promise	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
RaC Ree	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
RaD, RaE Ree	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ReC: Reliance	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
ReD: Reliance	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, thin layer.
RfC: Reliance	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Rw*. Riverwash				
SaG: Sansarc	Poor: slope, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, too clayey, area reclaim.
Sc: Scott	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, thin layer.
Sm: Simeon	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: thin layer.
SuC*:				
Simeon	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Valentine	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
SvF2*:				
Simeon	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope, thin layer.
Valentine	Fair: slope.	Fair: excess fines.	Unsuited: excess fines.	Poor: slope, too sandy.
VaE: Valentine	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
VbB: Valentine	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Ve: Verdel	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
WeC: Wewela	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ab: Albaton	Favorable	Compressible, low strength, shrink-swell.	Percs slowly, poor outlets, wetness.	Wetness, percs slowly.	Not needed	Percs slowly.
AnC: Anselmo	Seepage	Seepage, piping.	Not needed	Fast intake, soil blowing.	Complex slope, soil blowing.	Favorable.
AnD: Anselmo	Seepage	Seepage, piping.	Not needed	Fast intake, erodes easily, slope.	Complex slope, soil blowing.	Slope.
AnF: Anselmo	Seepage	Seepage, piping.	Not needed	Fast intake, erodes easily, slope.	Slope, soil blowing.	Slope.
ArF*:						
Anselmo	Seepage	Seepage, piping.	Not needed	Fast intake, erodes easily, slope.	Slope, soil blowing.	Slope.
Rock outcrop.						
Ba: Barney	Seepage	Seepage, wetness.	Floods, poor outlets, cutbanks cave.	Floods, wetness.	Not needed	Wetness.
Bd: Blake	Seepage	Favorable	Frost action, floods.	Floods, wetness.	Not needed	Wetness.
Be: Blendon	Seepage	Seepage, piping.	Not needed	Seepage, fast intake, soil blowing.	Not needed	Favorable.
BeC: Blendon	Seepage	Seepage, piping.	Not needed	Seepage, fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
BoD: Boyd	Slope, depth to rock.	Shrink-swell, low strength, compressible.	Not needed	Slope, slow intake, percs slowly.	Depth to rock, percs slowly, erodes easily.	Slope, percs slowly, erodes easily.
BrG: Bristow	Depth to rock, slope.	Thin layer	Not needed	Slope, rooting depth, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily.
Bs, Bt: Brocksburg	Seepage	Seepage	Not needed	Rooting depth	Rooting depth	Rooting depth.
Cb: Cass	Seepage	Seepage	Not needed	Floods, soil blowing.	Not needed	Favorable.
CrE2: Crofton	Slope	Erodes easily	Not needed	Erodes easily, slope.	Erodes easily, slope.	Slope, erodes easily.
DuB, DuC: Dunday	Seepage	Seepage, piping.	Not needed	Fast intake, seepage, soil blowing.	Too sandy, soil blowing.	Droughty.
DuD: Dunday	Seepage	Seepage, piping.	Not needed	Fast intake, seepage, soil blowing.	Too sandy, soil blowing.	Droughty, slope.
DxB: Dunday	Seepage	Seepage, piping.	Not needed	Fast intake, soil blowing.	Not needed	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Et----------------- Eltree	Seepage--------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Go, GrB----------- Grigston	Seepage--------	Low strength, piping.	Not needed-----	Floods---------	Not needed-----	Erodes easily.
Ha----------------- Hall	Seepage--------	Piping---------	Not needed-----	Favorable------	Not needed-----	Favorable.
He----------------- Haynie	Seepage--------	Piping---------	Not needed-----	Floods---------	Not needed-----	Favorable.
IfD---------------- Inavale	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
IgB, IhB, In------ Inavale	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, droughty, soil blowing.	Not needed-----	Droughty.
Jn----------------- Jansen	Seepage--------	Seepage--------	Not needed-----	Droughty, seepage.	Too sandy------	Droughty.
JnC---------------- Jansen	Seepage--------	Seepage--------	Not needed-----	Droughty, seepage.	Too sandy------	Slope, droughty.
JnD---------------- Jansen	Seepage--------	Seepage--------	Not needed-----	Droughty, seepage, slope.	Too sandy------	Slope, droughty.
LaD---------------- Labu	Slope, depth to rock.	Shrink-swell, low strength, compressible.	Not needed-----	Slope, slow intake, rooting depth.	Depth to rock, percs slowly.	Slope, percs slowly.
LcF*:						
Labu--------------	Slope, depth to rock.	Shrink-swell, low strength, compressible.	Not needed-----	Slope, slow intake, rooting depth.	Slope, depth to rock, percs slowly.	Slope, percs slowly.
Sansarc----------	Slope, depth to rock.	Thin layer, hard to pack.	Not needed-----	Slope, slow intake, rooting depth.	Slope, depth to rock, percs slowly.	Slope, rooting depth, droughty.
Le----------------- Leshara	Seepage--------	Piping, wetness.	Poor outlets, floods.	Floods, wetness.	Not needed-----	Favorable.
LsC---------------- Lynch	Slope, depth to rock.	Hard to pack, piping.	Not needed-----	Percs slowly, slow intake, rooting depth.	Depth to rock, percs slowly.	Percs slowly, depth to rock.
LsD---------------- Lynch	Slope, depth to rock.	Hard to pack, piping.	Not needed-----	Percs slowly, slow intake, rooting depth.	Depth to rock, percs slowly.	Slope, depth to rock, percs slowly.
LyD*:						
Lynch------------	Slope, depth to rock.	Hard to pack, piping.	Not needed-----	Percs slowly, slow intake, rooting depth.	Depth to rock, percs slowly.	Slope, depth to rock, percs slowly.
Bristow----------	Depth to rock, slope.	Thin layer-----	Not needed-----	Slope, rooting depth, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily.
LyF*:						
Lynch------------	Slope, depth to rock.	Hard to pack, piping.	Not needed-----	Percs slowly, slow intake, rooting depth.	Slope, depth to rock, percs slowly.	Slope, depth to rock, percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
LyF*:						
Bristow	Depth to rock, slope.	Thin layer	Not needed	Slope, rooting depth, slow intake.	Slope, depth to rock, erodes easily.	Slope, erodes easily.
MaG*:						
Mariaville	Seepage, depth to rock.	Thin layer	Not needed	Rooting depth, slope, erodes easily.	Slope, depth to rock.	Slope, rooting depth, erodes easily.
Paka	Favorable	Low strength, piping.	Not needed	Erodes easily, slope.	Erodes easily	Erodes easily.
MeE Meadin	Seepage	Seepage	Not needed	Fast intake, slope.	Rooting depth, slope.	Droughty, rooting depth, slope.
NoC Nora	Slope, seepage.	Low strength	Not needed	Favorable	Favorable	Favorable.
NoD Nora	Slope, seepage.	Low strength	Not needed	Slope	Favorable	Slope, erodes easily.
Oa Onawa	Favorable	Wetness	Percs slowly, poor outlets, wetness.	Percs slowly, wetness, floods.	Not needed	Favorable.
Oe, OeC O'Neill	Seepage	Seepage	Not needed	Seepage, droughty, rooting depth.	Rooting depth	Droughty, rooting depth.
OfD*:						
O'Neill	Seepage	Seepage	Not needed	Seepage, droughty, rooting depth.	Rooting depth	Droughty, rooting depth.
Meadin	Seepage	Seepage	Not needed	Fast intake, slope.	Rooting depth, slope.	Droughty, rooting depth, slope.
On Onita	Favorable	Hard to pack	Not needed	Slow intake	Not needed	Favorable.
Or Ord	Seepage	Seepage, wetness, piping.	Floods, poor outlets.	Wetness, soil blowing.	Not needed	Favorable.
PaC, Ph, PhC, PhD Paka	Favorable	Low strength, piping.	Favorable	Erodes easily, slope.	Erodes easily	Erodes easily.
PoC Promise	Slope	Low strength, shrink-swell, hard to pack.	Not needed	Slow intake, percs slowly.	Percs slowly, soil blowing.	Slope, erodes easily, percs slowly.
RaC Ree	Seepage	Favorable	Not needed	Favorable	Favorable	Favorable.
RaD Ree	Seepage	Favorable	Not needed	Slope	Favorable	Favorable.
RaE Ree	Seepage	Favorable	Not needed	Slope	Slope	Favorable.
ReC Reliance	Favorable	Favorable	Not needed	Favorable	Favorable	Favorable.
ReD Reliance	Favorable	Favorable	Not needed	Slope	Favorable	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
RfC------------- Reliance	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Rw*. Riverwash						
SaG------------- Sansarc	Slope, depth to rock.	Thin layer, hard to pack.	Not needed-----	Slope, slow intake, rooting depth.	Slope, depth to rock, percs slowly.	Slope, rooting depth, droughty.
Sc-------------- Scott	Favorable------	Shrink-swell---	Poor outlets, percs slowly.	Floods, wetness, percs slowly.	Wetness, poor outlets.	Not needed.
Sm-------------- Simeon	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, droughty, soil blowing.	Not needed-----	Droughty.
SuC*:						
Simeon----------	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
Valentine-------	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, soil blowing, droughty.	Soil blowing, too sandy.	Droughty.
SvF2*:						
Simeon----------	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, slope, droughty.	Slope, too sandy, soil blowing.	Slope, droughty.
Valentine-------	Seepage--------	Seepage, piping.	Not needed-----	Slope, fast intake, soil blowing.	Slope, soil blowing, too sandy.	Slope, droughty.
VaE------------- Valentine	Seepage--------	Seepage, piping.	Not needed-----	Slope, fast intake, soil blowing.	Soil blowing, too sandy.	Slope, droughty.
VbB------------- Valentine	Seepage--------	Seepage, piping.	Not needed-----	Fast intake, soil blowing, droughty.	Soil blowing, too sandy.	Droughty.
Ve-------------- Verdel	Favorable------	Piping, hard to pack.	Not needed-----	Droughty, percs slowly, slow intake.	Not needed-----	Percs slowly.
WeC------------- Wewela	Slope----------	Shrink-swell, low strength.	Not needed-----	Percs slowly, rooting depth, soil blowing.	Percs slowly, complex slope, rooting depth.	Percs slowly, slope, rooting depth.

* See map unit description for the composition and behavior of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ab-------------------- Albaton	Severe: floods, wetness, percs slowly.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
AnC------------------- Anselmo	Slight---------------	Slight---------------	Moderate: slope.	Slight.
AnD------------------- Anselmo	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
AnF------------------- Anselmo	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
ArF*:				
Anselmo---------------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Rock outcrop.				
Ba-------------------- Barney	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
Bd-------------------- Blake	Severe: floods.	Moderate: wetness, floods, too clayey.	Severe: floods.	Moderate: too clayey.
Be-------------------- Blendon	Slight---------------	Slight---------------	Slight---------------	Slight.
BeC------------------- Blendon	Slight---------------	Slight---------------	Moderate: slope.	Slight.
BoD------------------- Boyd	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: slope, percs slowly, too clayey.	Severe: too clayey.
BrG------------------- Bristow	Severe: too clayey, slope.	Severe: too clayey, slope.	Severe: slope, too clayey, depth to rock.	Severe: too clayey, slope.
Bs, Bt---------------- Brocksburg	Slight---------------	Slight---------------	Slight---------------	Slight.
Cb-------------------- Cass	Severe: floods.	Slight---------------	Moderate: floods.	Slight.
CrE2------------------ Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
DuB------------------- Dunday	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
DuC------------------- Dunday	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
DuD------------------- Dunday	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
DxB------------------- Dunday	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Et-------------------- Eltree	Slight---------------	Slight---------------	Slight---------------	Slight.
Go-------------------- Grigston	Severe: floods.	Moderate: too clayey, floods.	Slight---------------	Slight.
GrB------------------- Grigston	Severe: floods.	Moderate: too clayey, floods.	Severe: floods.	Slight.
Ha-------------------- Hall	Slight---------------	Slight---------------	Slight---------------	Slight.
He-------------------- Haynie	Severe: floods.	Slight---------------	Moderate: floods.	Slight.
IfD, IgB-------------- Inavale	Severe: floods, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
IhB------------------- Inavale	Severe: floods.	Moderate: too sandy.	Moderate: too sandy, floods.	Moderate: too sandy.
In-------------------- Inavale	Severe: floods.	Slight---------------	Moderate: floods.	Slight.
Jn-------------------- Jansen	Slight---------------	Slight---------------	Slight---------------	Slight.
JnC------------------- Jansen	Slight---------------	Slight---------------	Moderate: slope.	Slight.
JnD------------------- Jansen	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
LaD------------------- Labu	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.
LcF*:				
Labu-----------------	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey.
Sansarc--------------	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey.	Severe: slope, too clayey, depth to rock.	Severe: too clayey.
Le-------------------- Leshara	Severe: floods.	Moderate: wetness.	Moderate: wetness, floods.	Slight.
LsC------------------- Lynch	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: percs slowly, too clayey.	Severe: too clayey.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
LsD: Lynch	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: percs slowly, slope, too clayey.	Severe: too clayey.
LyD*:				
Lynch	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: percs slowly, slope, too clayey.	Severe: too clayey.
Bristow	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey, depth to rock.	Severe: too clayey.
LyF*:				
Lynch	Severe: too clayey, percs slowly, slope.	Severe: too clayey, slope.	Severe: percs slowly, slope, too clayey.	Severe: too clayey.
Bristow	Severe: too clayey, slope.	Severe: too clayey, slope.	Severe: slope, too clayey, depth to rock.	Severe: too clayey.
MaG*:				
Mariaville	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.
Paka	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
MeE: Meadin	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
NoC: Nora	Slight	Slight	Moderate: slope.	Slight.
NoD: Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Oa: Onawa	Severe: floods, too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Oe: O'Neill	Slight	Slight	Slight	Slight.
OeC: O'Neill	Slight	Slight	Moderate: slope.	Slight.
OfD*:				
O'Neill	Slight	Slight	Severe: slope.	Slight.
Meadin	Slight	Slight	Severe: slope.	Slight.
On: Onita	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Or: Ord	Severe: floods.	Moderate: wetness.	Moderate: floods, wetness.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
PaC, Ph, PhC: Paka	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
PhD: Paka	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
PoC: Promise	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
RaC: Ree	Slight	Slight	Moderate: slope.	Slight.
RaD, RaE: Ree	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
ReC: Reliance	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
ReD: Reliance	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight.
RfC: Reliance	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
Rw*. Riverwash				
SaG: Sansarc	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey.	Severe: slope, too clayey, depth to rock.	Severe: slope, too clayey.
Sc: Scott	Severe: floods, wetness, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods, percs slowly.	Severe: wetness.
Sm: Simeon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
SuC*:				
Simeon	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Valentine	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
SvF2*:				
Simeon	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy.
Valentine	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VaE: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
VbB-------------------- Valentine	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Ve--------------------- Verdel	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
WeC-------------------- Wewela	Moderate: percs slowly.	Slight---------------	Moderate: slope.	Slight.

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ab: Albaton	Fair	Fair	Fair	Poor	Very poor.	Fair	Good	Good	Fair	Poor	Good	Fair.
AnC, AnD: Anselmo	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
AnF: Anselmo	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
ArF*:												
Anselmo	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Rock outcrop.												
Ba: Barney	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Bd: Blake	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	Good.
Be, BeC: Blendon	Fair	Fair	Good	Fair	Poor	Good	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
BoD: Boyd	Fair	Good	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Fair	Very poor.	Fair.
BrG: Bristow	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Bs, Bt: Brocksburg	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Cb: Cass	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
CrE2: Crofton	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
DuB, DuC, DuD: Dunday	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
DxB: Dunday	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Et: Eltree	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Poor	Very poor.	Good.
Go, GrB: Grigston	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	Good.
Ha: Hall	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
He: Haynie	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
IfD: Inavale	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
IgB: Inavale	Very poor.	Poor	Good	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Good.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
IhB----------------- Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
In------------------ Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Jn, JnC, JnD-------- Jansen	Fair	Good	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
LaD----------------- Labu	Fair	Good	Poor	Poor	Poor	Poor	Poor	Very poor.	Fair	Poor	Very poor.	Fair.
LcF*:												
Labu----------------	Poor	Fair	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Sansarc-------------	Poor	Poor	Fair	Poor	Very poor.	Poor	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Le------------------ Leshara	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
LsC, LsD------------ Lynch	Fair	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
LyD*:												
Lynch---------------	Fair	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Bristow-------------	Very poor.	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
LyF*:												
Lynch---------------	Poor	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Bristow-------------	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
MaG*:												
Mariaville----------	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Paka----------------	Poor	Fair	Good	Fair	Fair	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
MeE----------------- Meadin	Very poor.	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
NoC----------------- Nora	Good	Good	Good	Good	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
NoD----------------- Nora	Fair	Good	Good	Good	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor.	Poor	Good.
Oa------------------ Onawa	Fair	Fair	Fair	Poor	Poor	Fair	Good	Good	Fair	Poor	Good	Fair.
Oe, OeC------------- O'Neill	Fair	Good	Good	Fair	Good	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
OfD*:												
O'Neill-------------	Poor	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Meadin--------------	Very poor.	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
On------------------ Onita	Good	Good	Fair	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Or----------------- Ord	Good	Good	Good	Fair	Good	Good	Fair	Fair	Good	Fair	Fair	Good.
PaC, PhC, PhD------ Paka	Fair	Good	Good	Fair	Fair	Good	Poor	Very poor.	Fair	Fair	Very poor.	Good.
Ph----------------- Paka	Good	Good	Good	Fair	Fair	Good	Poor	Very poor.	Good	Fair	Very poor.	Good.
PoC---------------- Promise	Fair	Fair	Good	Fair	Very poor.	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Good.
RaC---------------- Ree	Good	Good	Good	Good	Very poor.	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
RaD---------------- Ree	Fair	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
RaE---------------- Ree	Poor	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
ReC---------------- Reliance	Good	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
ReD---------------- Reliance	Fair	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
RfC---------------- Reliance	Good	Good	Good	Good	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Rw*. Riverwash												
SaG---------------- Sansarc	Very poor.	Very poor.	Fair	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
Sc----------------- Scott	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Good	Good	Poor	Very poor.	Good	Poor.
Sm----------------- Simeon	Poor	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
SuC*:												
Simeon------------	Poor	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Valentine---------	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
SvE2*:												
Simeon------------	Poor	Poor	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Valentine---------	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VaE---------------- Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VbB---------------- Valentine	Fair	Good	Fair	Poor	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Ve----------------- Verdel	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Very poor.	Fair	Poor	Very poor.	Poor.
WeC---------------- Wewela	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Good.

* See map unit description for the composition and behavior of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ab----------------- Albaton	0-7	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	7-60	Silty clay, clay	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
AnC, AnD, AnF------ Anselmo	0-16	Fine sandy loam	SM, ML	A-4, A-2	0	100	95-100	90-100	30-60	<25	NP-4
	16-21	Fine sandy loam, loam.	SM, ML	A-4	0	100	100	90-100	40-65	<24	NP-4
	21-60	Sandy loam, loamy fine sand, fine sand.	SM, SP-SM	A-4, A-2	0	100	100	65-100	12-40	<20	NP
ArF*:											
Anselmo-----------	0-16	Fine sandy loam	SM, ML	A-4, A-2	0	100	95-100	90-100	30-50	<25	NP-4
	16-21	Fine sandy loam, loam.	SM, ML	A-4	0	100	100	90-100	40-65	<24	NP-4
	21-60	Fine sandy loam, loamy fine sand, fine sand.	SM, SP-SM	A-4, A-2	0	100	100	65-100	12-40	<20	NP
Rock outcrop.											
Ba----------------- Barney	0-5	Silt loam-------	ML, CL	A-4, A-6	0	90-100	90-100	85-95	60-95	20-35	3-15
	5-10	Sandy loam, loamy fine sand.	SM, ML	A-2, A-4	0	90-100	90-100	55-80	20-60	---	NP
	10-60	Sand and gravel	SP, GP, SM, GM	A-1, A-2, A-3	0	45-100	35-80	5-70	0-25	---	NP
Bd----------------- Blake	0-25	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	85-95	30-50	10-30
	25-60	Silt loam, loam, very fine sandy loam.	ML, CL	A-4, A-6	0	100	100	80-90	75-90	30-40	5-15
Be, BeC------------ Blendon	0-16	Fine sandy loam	SM	A-2, A-4	0	100	100	60-100	25-50	20-30	NP-5
	16-42	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	100	60-100	25-50	20-30	NP-5
	42-60	Fine sandy loam, loamy fine sand, loamy sand.	SM, SP-SM	A-2	0	100	90-100	50-100	10-35	<30	NP-5
BoD---------------- Boyd	0-32	Silty clay, clay	CH, MH	A-7	0	95-100	95-100	95-100	90-100	55-90	26-65
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
BrG---------------- Bristow	0-7	Silty clay------	CH, CL, MH	A-7	0	100	100	95-100	90-100	45-65	25-40
	7-17	Very shaly clay	CL, CH	A-7	0	100	100	100	95-100	45-65	25-45
	17-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Bs----------------- Brocksburg	0-18	Fine sandy loam	SM	A-4	0	100	95-100	70-85	35-50	<20	NP
	18-32	Clay loam, loam	CL	A-7, A-6	0	97-100	95-100	85-100	70-80	35-50	11-30
	32-60	Sand and gravel	SM, SP, SP-SM	A-1, A-3	0	85-100	40-95	30-60	3-20	---	NP
Bt----------------- Brocksburg	0-14	Loam-----------	CL, ML	A-6, A-4	0	97-100	95-100	75-100	55-90	25-40	3-15
	14-34	Clay loam, loam	CL	A-7, A-6	0	97-100	95-100	85-100	70-80	35-50	11-30
	34-60	Sand and gravel	SM, SP, SP-SM	A-1, A-3	0	85-100	40-95	30-60	3-20	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Cb----------------- Cass	0-12	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	12-26	Fine sandy loam, sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	26-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
CrE2--------------- Crofton	0-6	Silt loam-------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-22
	6-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	95-100	32-40	11-18
DuB, DuC, DuD------ Dunday	0-15	Loamy fine sand	SM, SM-SC	A-2	0	100	100	90-100	13-35	<25	NP-4
	15-60	Loamy fine sand, fine sand, loamy sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	50-95	5-35	<25	NP-4
DxB---------------- Dunday	0-14	Loamy fine sand	SM	A-2, A-4	0	100	100	75-85	30-50	<25	NP-4
	14-34	Loamy sand, loamy fine sand.	SM	A-2, A-4	0	100	100	50-95	15-40	<25	NP-4
	34-48	Sandy loam------	SM, SC, SM-SC	A-2, A-4	0	100	100	60-70	30-40	20-30	3-10
	48-60	Coarse sand, gravel.	SP, SP-SM, SM	A-1	0	85-90	60-85	30-50	3-20	---	NP
Et----------------- Eltree	0-25	Silt loam-------	CL, ML	A-4, A-6	0	100	100	85-100	65-100	28-40	5-15
	25-60	Silt loam, very fine sandy loam, silty clay loam.	CL, ML	A-4, A-6	0	100	100	85-100	85-100	25-40	5-20
Go, GrB------------ Grigston	0-15	Silt loam-------	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	25-50	5-25
	15-31	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	95-100	85-100	25-50	5-30
	31-60	Silt loam, loam, fine sandy loam.	CL-ML, CL, SC	A-4, A-6	0	100	100	75-100	45-90	25-40	5-20
Ha----------------- Hall	0-5	Silt loam-------	CL, CL-ML	A-4, A-6	0	100	100	95-100	95-100	25-40	5-20
	5-36	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-30
	36-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
He----------------- Haynie	0-46	Silt loam, very fine sandy loam.	ML, CL	A-4, A-6	0	100	100	85-100	70-100	30-40	5-15
	46-60	Fine sand-------	SM	A-2	0	100	100	65-80	20-35	---	NP
IfD, IgB----------- Inavale	0-6	Fine sand-------	SM, SP-SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	6-12	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	12-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
IhB---------------- Inavale	0-9	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	9-19	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	19-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
In------------------ Inavale	0-16	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-4	0	100	95-100	65-85	35-55	<20	NP-5
	16-26	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	26-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Jn, JnC, JnD------- Jansen	0-13	Loam------------	CL, ML	A-6, A-4	0	100	100	90-100	80-95	25-40	3-15
	13-32	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	95-100	90-100	80-100	70-80	30-45	10-25
	32-60	Coarse sand, gravel.	SW, SW-SM, SP, SP-SM	A-3, A-1, A-2	0	85-100	45-100	35-65	3-10	---	NP
LaD---------------- Labu	0-34	Silty clay------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	34-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
LcF*:											
Labu--------------	0-34	Silty clay------	CH, MH	A-7	0	100	95-100	90-100	85-100	50-85	20-50
	34-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Sansarc-----------	0-16	Silty clay------	CH, MH	A-7	0	100	95-100	90-100	75-100	50-100	20-65
	16-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Le----------------- Leshara	0-21	Silt loam-------	ML, SM	A-4	0	100	100	70-100	40-90	20-35	NP-7
	21-32	Silt loam, loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	60-90	20-35	3-15
	32-60	Stratified fine sand to silt loam.	SM, ML, CL, SC	A-4, A-2, A-3	0	100	100	55-95	15-90	<30	NP-15
LsC, LsD----------- Lynch	0-8	Silty clay------	CH, MH	A-7	0	100	100	95-100	90-95	50-60	25-35
	8-28	Silty clay, clay	CH	A-7	0	100	100	95-100	75-100	50-60	25-35
	28-36	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-100	45-65	25-40
	36-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
LyD*, LyF*:											
Lynch-------------	0-8	Silty clay------	CH, MH	A-7	0	100	100	95-100	90-95	50-60	25-35
	8-28	Silty clay, clay	CH	A-7	0	100	100	95-100	75-100	50-60	25-35
	28-36	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-100	45-65	25-40
	36-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Bristow-----------	0-7	Silty clay------	CH, CL, MH	A-7	0	100	100	95-100	90-100	45-65	25-40
	7-17	Very shaly clay	CL, CH	A-7	0	100	100	100	95-100	45-65	25-45
	17-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
MaG*:											
Mariaville--------	0-5	Loam------------	CL	A-4, A-6	0	95-100	95-100	85-100	70-95	28-35	8-15
	5-17	Loam, silty clay loam, silt loam.	CL	A-6	0	95-100	95-100	85-100	70-95	30-40	11-18
	17-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
MaG*:											
Paka----------------	0-8	Loam------------	CL	A-4, A-6	0	100	100	95-100	65-100	20-35	8-18
	8-26	Silty clay loam, clay loam, silt loam.	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
	26-48	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	8-20
	48-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
MeE---------------- Meadin	0-8	Sandy loam------	SM, ML	A-2, A-4	0	95-100	93-100	60-80	30-55	<20	NP-5
	8-13	Sandy loam, gravelly loamy sand, gravelly sandy loam.	SM, SP-SM, GM, GP-GM	A-1, A-3, A-2	0	40-90	35-87	17-65	5-35	---	NP
	13-60	Gravelly coarse sand, very gravelly coarse sand.	SP-SM, SP, GP-GM, GP	A-1	0	30-80	18-60	9-35	1-8	---	NP
NoC, NoD----------- Nora	0-7	Silt loam-------	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	28-45	6-23
	7-34	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	11-27
	34-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	27-45	6-24
Oa----------------- Onawa	0-7	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	7-28	Silty clay------	CH	A-7	0	100	100	95-100	95-100	60-85	40-60
	28-60	Silt loam, very fine sandy loam, loam.	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
Oe, OeC------------ O´Neill	0-9	Fine sandy loam	SM, ML, SC, CL	A-2, A-4	0	95-100	95-100	70-85	30-55	<25	NP-10
	9-34	Fine sandy loam, coarse sandy loam.	SC, SM-SC	A-2, A-4	0	95-100	95-100	60-75	30-50	<30	4-10
	34-60	Stratified sand to gravelly sand.	SP, SP-SM	A-1	0	70-100	50-90	25-35	0-5	---	NP
OfD*:											
O´Neill-----------	0-9	Fine sandy loam	SM, ML, SC, CL	A-2, A-4	0	95-100	95-100	70-85	30-55	<25	NP-10
	9-34	Fine sandy loam, coarse sandy loam.	SC, SM-SC	A-2, A-4	0	95-100	95-100	60-75	30-50	<30	4-10
	34-60	Stratified sand to gravelly sand.	SP, SP-SM	A-1	0	70-100	50-90	25-35	0-5	---	NP
Meadin------------	0-8	Fine sandy loam	SM, ML	A-2, A-4	0	95-100	93-100	60-80	30-55	<20	NP-5
	8-13	Sandy loam, very gravelly loamy sand, gravelly sandy loam.	SM, SP-SM, GM, GP-GM	A-1, A-3, A-2	0	40-90	35-87	17-65	5-35	---	NP
	13-60	Gravelly coarse sand, very gravelly coarse sand.	SP-SM, SP, GP-GM, GP	A-1	0	30-80	18-60	9-35	1-8	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
On------------------ Onita	0-18	Silt loam-------	ML, CL	A-4, A-7, A-6	0	100	95-100	90-100	70-100	30-45	5-18
	18-32	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0	100	95-100	90-100	75-100	35-60	10-35
	32-60	Silty clay loam, loam, silt loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	85-100	65-100	30-55	10-30
Or------------------ Ord	0-11	Fine sandy loam	ML, SM	A-2, A-4	0	95-100	95-100	70-98	30-80	20-35	NP-10
	11-30	Fine sandy loam, loamy fine sand.	ML, SM	A-2, A-4	0	95-100	95-100	70-90	30-55	20-35	NP-10
	30-60	Stratified sand to fine sandy loam.	SM, SC, SP-SM, SM-SC	A-2, A-3, A-4	0	95-100	95-100	50-95	5-50	10-25	NP-10
PaC----------------- Paka	0-9	Fine sandy loam	SM	A-4	0	100	100	70-85	40-50	---	NP
	9-27	Sandy clay loam, clay loam.	CL	A-6	0	100	100	90-100	55-95	30-40	15-25
	27-46	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	8-20
	46-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Ph, PhC, PhD-------- Paka	0-8	Loam------------	CL	A-4, A-6	0	100	100	95-100	65-100	20-35	8-18
	8-26	Silty clay loam, clay loam, silt loam.	CL	A-6	0	100	100	95-100	75-95	30-40	15-25
	26-48	Silt loam, very fine sandy loam.	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	8-20
	48-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
PoC----------------- Promise	0-18	Silty clay------	CH, MH	A-7	0	100	100	90-100	80-100	50-70	20-40
	18-33	Clay------------	CH, MH	A-7	0	100	100	90-100	85-100	50-85	20-50
	33-60	Clay, silty clay	CH, MH	A-7	0	100	100	90-100	85-100	50-85	25-55
RaC, RaD, RaE------ Ree	0-7	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	80-100	70-95	25-40	5-15
	7-22	Clay loam, sandy clay loam, silty clay loam.	CL	A-6, A-7	0	100	90-100	80-100	65-85	30-45	10-20
	22-40	Sandy loam, loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6	0	100	85-100	75-100	35-85	25-40	5-20
	40-60	Loamy fine sand, fine sandy loam, sandy loam.	ML, SM	A-2, A-4	0	100	100	70-85	30-55	20-35	NP-10
ReC, ReD----------- Reliance	0-10	Silt loam-------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	70-100	25-40	5-15
	10-28	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-60	15-35
	28-50	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	70-100	30-50	10-25
	50-60	Fine sandy loam	SM-SC, CL-ML	A-4	0	100	100	80-85	45-55	20-35	4-12
RfC----------------- Reliance	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-100	35-45	10-22
	10-28	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-60	15-35
	28-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-100	30-55	10-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Rw*. Riverwash											
SaG----------------- Sansarc	0-16	Silty clay, shaly clay.	CH, MH	A-7	0	100	95-100	90-100	75-100	50-100	20-65
	16-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Sc------------------ Scott	0-8	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-35	2-12
	8-48	Silty clay, clay	CH	A-7	0	100	100	100	95-100	50-75	30-45
	48-56	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
	56-64	Silt loam, silty clay loam, clay loam.	CL	A-4, A-6	0	100	100	90-100	90-100	25-40	8-20
Sm------------------ Simeon	0-5	Loamy sand------	SM, SP-SM	A-2	0	95-100	90-100	51-80	10-30	---	NP
	5-60	Sand, coarse sand, loamy coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	85-100	40-80	2-15	---	NP
SuC*: Simeon------------	0-5	Loamy sand------	SM, SP-SM	A-2	0	95-100	90-100	51-80	10-30	---	NP
	5-60	Sand, coarse sand, loamy coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	85-100	40-80	2-15	---	NP
Valentine---------	0-11	Loamy sand------	SM, SP, SP-SM	A-2, A-3	0	100	100	95-100	2-35	---	NP
	11-60	Fine sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	100	90-100	2-20	---	NP
SvF2*: Simeon------------	0-5	Loamy sand------	SM, SP-SM	A-2	0	95-100	90-100	51-80	10-30	---	NP
	5-60	Sand, coarse sand, loamy coarse sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	85-100	40-80	2-15	---	NP
Valentine---------	0-11	Fine sand-------	SM, SP, SP-SM	A-2, A-3	0	100	100	85-100	2-25	---	NP
	11-60	Fine sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	100	90-100	2-20	---	NP
VaE----------------- Valentine	0-11	Fine sand-------	SM, SP, SP-SM	A-2, A-3	0	100	100	85-100	2-25	---	NP
	11-60	Fine sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	100	90-100	2-20	---	NP
VbB----------------- Valentine	0-11	Loamy sand------	SM, SP, SP-SM	A-2, A-3	0	100	100	95-100	2-35	---	NP
	11-60	Fine sand, loamy fine sand.	SM, SP, SP-SM	A-2, A-3	0	100	100	90-100	2-20	---	NP
Ve------------------ Verdel	0-14	Silty clay------	CH	A-7	0	100	95-100	95-100	85-100	50-70	27-45
	14-60	Silty clay, clay	CH	A-7	0	100	95-100	95-100	85-100	50-70	27-45
WeC----------------- Wewela	0-8	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	100	70-85	40-55	15-30	NP-10
	8-15	Sandy clay loam	SC, CL	A-6	0	100	100	60-100	35-55	30-40	10-20
	15-22	Clay, shaly clay	CH, MH	A-7	0	100	95-100	90-100	85-100	55-85	20-50
	22-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Wind erodi-bility group
						Uncoated steel	Concrete	
	In	In/hr	In/in	pH				
Ab	0-7	<0.2	0.11-0.13	7.4-8.4	High	High	Low	4
Albaton	7-60	<0.2	0.11-0.13	7.4-8.4	High	High	Low	
AnC, AnD, AnF	0-16	2.0-6.0	0.16-0.20	6.1-7.8	Low	Moderate	Low	3
Anselmo	16-21	2.0-6.0	0.15-0.19	6.6-7.8	Low	Moderate	Low	
	21-60	2.0-6.0	0.14-0.16	6.6-8.4	Low	Moderate	Low	
ArF*:								
Anselmo	0-16	2.0-6.0	0.16-0.20	6.1-7.8	Low	Moderate	Low	3
	16-21	2.0-6.0	0.15-0.19	6.6-7.8	Low	Moderate	Low	
	21-60	2.0-6.0	0.14-0.16	6.6-8.4	Low	Moderate	Low	
Rock outcrop.								
Ba	0-5	0.6-2.0	0.20-0.23	6.6-8.4	Low	High	Low	4L
Barney	5-10	2.0-20	0.09-0.14	7.4-8.4	Low	High	Low	
	10-60	>20	0.02-0.04	6.6-7.8	Low	High	Low	
Bd	0-25	0.2-2.0	0.20-0.22	7.4-8.4	High	High	Low	4L
Blake	25-60	0.6-6.0	0.20-0.22	7.4-8.4	Low	High	Low	
Be, BeC	0-16	2.0-6.0	0.11-0.17	5.6-7.3	Low	Moderate	Low	3
Blendon	16-42	2.0-6.0	0.11-0.17	6.1-7.3	Low	Moderate	Low	
	42-60	6.0-20	0.08-0.15	6.6-8.4	Low	Moderate	Low	
BoD	0-32	<0.2	0.08-0.14	6.6-8.4	High	High	Moderate	4
Boyd	32-60	---	---	---	---	---	---	
BrG	0-7	0.06-0.2	0.10-0.12	7.4-8.4	High	High	Moderate	4
Bristow	7-17	0.06-0.2	0.08-0.10	7.4-8.4	High	High	Moderate	
	17-60	---	---	---	---	---	---	
Bs	0-18	2.0-6.0	0.16-0.18	6.1-7.3	Low	Low	Low	3
Brocksburg	18-32	0.6-2.0	0.15-0.19	6.6-7.8	Moderate	Low	Low	
	32-60	>20	0.02-0.04	6.6-7.8	Low	Low	Low	
Bt	0-14	0.6-2.0	0.20-0.24	6.1-7.3	Low	Low	Low	5
Brocksburg	14-34	0.6-2.0	0.15-0.19	6.6-7.8	Moderate	Low	Low	
	34-60	>20	0.02-0.04	6.6-7.8	Low	Low	Low	
Cb	0-12	2.0-6.0	0.16-0.18	5.6-7.3	Low	Moderate	Low	3
Cass	12-26	2.0-6.0	0.15-0.17	6.1-8.4	Low	Moderate	Low	
	26-60	6.0-20	0.05-0.10	6.1-8.4	Low	Moderate	Low	
CrE2	0-6	0.6-2.0	0.22-0.24	7.4-8.4	Low	Low	Low	4L
Crofton	6-60	0.6-2.0	0.20-0.22	7.4-8.4	Low	Low	Low	
DuB, DuC, DuD	0-15	2.0-6.0	0.10-0.12	6.1-7.3	Low	Low	Low	2
Dunday	15-60	2.0-20	0.09-0.11	6.1-7.8	Low	Low	Low	
DxB	0-14	2.0-6.0	0.12-0.15	6.1-7.3	Low	Low	Low	2
Dunday	14-34	2.0-20	0.09-0.13	6.6-7.8	Low	Low	Low	
	34-48	2.0-6.0	0.11-0.13	7.4-7.8	Low	Low	Low	
	48-60	>20	0.02-0.04	7.4-7.8	Low	Low	Low	
Et	0-25	0.6-2.0	0.20-0.24	6.6-8.4	Low	Low	Low	6
Eltree	25-60	0.6-2.0	0.17-0.22	7.4-8.4	Low	Low	Low	
Go, GrB	0-15	0.6-2.0	0.21-0.24	6.6-7.8	Low	Low	Low	6
Grigston	15-31	0.6-2.0	0.18-0.22	7.4-8.4	Low	Low	Low	
	31-60	0.6-2.0	0.16-0.22	7.4-8.4	Low	Low	Low	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Wind erodi-bility group
						Uncoated steel	Concrete	
	In	In/hr	In/in	pH				
Ha-----------------	0-5	0.6-2.0	0.22-0.24	6.1-7.3	Moderate-----	Moderate-----	Low----------	6
Hall	5-36	0.2-0.6	0.18-0.20	6.1-6.5	Moderate-----	Moderate-----	Low----------	
	36-60	0.6-2.0	0.20-0.22	6.6-7.8	Moderate-----	Moderate-----	Low----------	
He-----------------	0-46	0.6-2.0	0.21-0.23	7.4-8.4	Low----------	Low----------	Low----------	4L
Haynie	46-60	6.0-20	0.06-0.08	7.4-8.4	Low----------	Low----------	Low----------	
IfD, IgB-----------	0-6	6.0-20	0.07-0.09	6.6-8.4	Low----------	High---------	Low----------	1
Inavale	6-12	6.0-20	0.09-0.11	6.6-8.4	Low----------	High---------	Low----------	
	12-60	6.0-20	0.05-0.07	6.6-8.4	Low----------	High---------	Low----------	
IhB----------------	0-9	>6.0	0.10-0.12	6.6-8.4	Low----------	High---------	Low----------	2
Inavale	9-19	6.0-20	0.09-0.11	6.6-8.4	Low----------	High---------	Low----------	
	19-60	6.0-20	0.05-0.07	6.6-8.4	Low----------	High---------	Low----------	
In-----------------	0-16	2.0-6.0	0.13-0.18	6.6-8.4	Low----------	High---------	Low----------	3
Inavale	16-26	6.0-20	0.09-0.11	6.6-8.4	Low----------	High---------	Low----------	
	26-60	6.0-20	0.05-0.07	6.6-8.4	Low----------	High---------	Low----------	
Jn, JnC, JnD-------	0-13	0.6-2.0	0.22-0.24	5.1-7.3	Low----------	Moderate-----	Low----------	6
Jansen	13-32	0.6-2.0	0.15-0.17	5.1-7.3	Moderate-----	Moderate-----	Low----------	
	32-60	>20	0.02-0.04	5.1-7.3	Very low-----	Moderate-----	Low----------	
LaD----------------	0-34	0.06-0.2	0.08-0.12	7.4-8.4	High---------	High---------	Moderate-----	4
Labu	34-60	---	---	---	-------------	-------------	-------------	
LcF*:								
Labu---------------	0-34	0.06-0.2	0.08-0.12	7.4-8.4	High---------	High---------	Moderate-----	4
	34-60	---	---	---	-------------	-------------	-------------	
Sansarc------------	0-16	0.06-0.2	0.08-0.12	6.6-8.4	High---------	High---------	Moderate-----	8
	16-60	---	---	---	-------------	-------------	-------------	
Le-----------------	0-21	0.6-6.0	0.16-0.24	6.6-8.4	Low----------	High---------	Low----------	5
Leshara	21-32	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	High---------	Low----------	
	32-60	0.6-2.0	0.09-0.22	7.4-8.4	Low----------	High---------	Low----------	
LsC, LsD-----------	0-8	<0.06	0.12-0.14	7.9-8.4	High---------	Moderate-----	High---------	4
Lynch	8-28	<0.2	0.09-0.13	7.9-8.4	High---------	High---------	High---------	
	28-36	0.06-0.6	0.09-0.17	7.9-9.0	High---------	High---------	High---------	
	36-60	---	---	---	-------------	-------------	-------------	
LyD*, LyF*:								
Lynch--------------	0-8	<0.06	0.12-0.14	7.9-8.4	High---------	Moderate-----	High---------	4
	8-28	<0.2	0.09-0.13	7.9-8.4	High---------	High---------	High---------	
	28-36	0.06-0.6	0.09-0.17	7.9-9.0	High---------	High---------	High---------	
	36-60	---	---	---	-------------	-------------	-------------	
Bristow------------	0-7	0.06-0.2	0.10-0.12	7.4-8.4	High---------	High---------	Moderate-----	4
	7-17	0.06-0.2	0.08-0.10	7.4-8.4	High---------	High---------	Moderate-----	
	17-60	---	---	---	-------------	-------------	-------------	
MaG*:								
Mariaville---------	0-5	0.6-2.0	0.20-0.24	6.6-7.8	Low----------	Moderate-----	Low----------	6
	5-17	0.6-2.0	0.17-0.22	7.4-8.4	Low----------	Moderate-----	Low----------	
	17-60	---	---	---	-------------	-------------	-------------	
Paka---------------	0-8	0.6-2.0	0.22-0.24	6.6-7.3	Moderate-----	High---------	Low----------	6
	8-26	0.6-2.0	0.15-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	26-48	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	48-60	---	---	---	-------------	-------------	-------------	
MeE----------------	0-8	0.6-2.0	0.13-0.18	5.1-7.3	Low----------	Low----------	Moderate-----	3
Meadin	8-13	6.0-20	0.09-0.11	5.1-7.3	Low----------	Low----------	Moderate-----	
	13-60	>20	0.05-0.07	6.1-7.3	Low----------	Low----------	Low----------	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea- bility	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Wind erodi- bility group
						Uncoated steel	Concrete	
	In	In/hr	In/in	pH				
NoC, NoD-----------	0-7	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	Moderate-----	Low----------	6
Nora	7-34	0.6-2.0	0.17-0.20	6.6-8.4	Moderate-----	Moderate-----	Low----------	
	34-60	0.6-2.0	0.17-0.20	6.6-8.4	Moderate-----	Moderate-----	Low----------	
Oa-----------------	0-7	0.06-0.2	0.12-0.14	7.4-8.4	High---------	High---------	Low----------	4
Onawa	7-28	0.06-0.2	0.12-0.14	7.4-8.4	High---------	High---------	Low----------	
	28-60	2.0-6.0	0.20-0.22	7.9-8.4	Moderate-----	High---------	Low----------	
Oe, OeC------------	0-9	2.0-20	0.10-0.18	6.1-6.5	Low----------	Moderate-----	Low----------	3
O'Neill	9-34	2.0-6.0	0.15-0.17	6.6-7.3	Low----------	Moderate-----	Low----------	
	34-60	>20	0.02-0.04	6.6-7.3	Low----------	Moderate-----	Low----------	
OfD*:								
O'Neill-----------	0-9	2.0-20	0.10-0.18	6.1-6.5	Low----------	Moderate-----	Low----------	3
	9-34	2.0-6.0	0.15-0.17	6.6-7.3	Low----------	Moderate-----	Low----------	
	34-60	>20	0.02-0.04	6.6-7.3	Low----------	Moderate-----	Low----------	
Meadin------------	0-8	0.6-2.0	0.13-0.18	5.1-7.3	Low----------	Low----------	Moderate-----	3
	8-13	6.0-20	0.09-0.11	5.1-7.3	Low----------	Low----------	Moderate-----	
	13-60	>20	0.05-0.07	6.1-7.3	Low----------	Low----------	Low----------	
On-----------------	0-18	0.6-2.0	0.19-0.22	5.6-7.3	Moderate-----	Moderate-----	Low----------	6
Onita	18-32	0.2-0.6	0.11-0.17	6.1-7.3	High---------	High---------	Low----------	
	32-60	0.2-0.6	0.17-0.20	7.4-8.4	High---------	High---------	Low----------	
Or-----------------	0-11	0.6-6.0	0.16-0.24	6.1-8.4	Low----------	High---------	Low----------	3
Ord	11-30	2.0-6.0	0.15-0.17	6.6-8.4	Low----------	High---------	Low----------	
	30-60	2.0-20	0.02-0.04	6.6-8.4	Low----------	High---------	Low----------	
PaC----------------	0-9	2.0-6.0	0.16-0.18	6.6-7.3	Low----------	High---------	Low----------	3
Paka	9-27	0.6-2.0	0.15-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	27-46	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	46-60	---	---	---	-------------	-------------	-------------	
Ph, PhC, PhD-------	0-8	0.6-2.0	0.22-0.24	6.6-7.3	Moderate-----	High---------	Low----------	6
Paka	8-26	0.6-2.0	0.15-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	26-48	0.6-2.0	0.20-0.22	7.4-8.4	Moderate-----	High---------	Low----------	
	48-60	---	---	---	-------------	-------------	-------------	
PoC----------------	0-18	<0.2	0.10-0.14	6.1-7.8	High---------	High---------	Low----------	4
Promise	18-33	<0.06	0.08-0.14	7.4-9.0	High---------	High---------	Low----------	
	33-60	<0.06	0.10-0.12	7.4-9.0	High---------	High---------	Low----------	
RaC, RaD, RaE------	0-7	0.6-2.0	0.18-0.22	6.1-7.3	Moderate-----	Moderate-----	Low----------	6
Ree	7-22	0.6-2.0	0.17-0.22	6.6-8.4	Moderate-----	Moderate-----	Low----------	
	22-40	0.6-2.0	0.09-0.20	7.9-8.4	Moderate-----	High---------	Low----------	
	40-60	2.0-6.0	0.08-0.16	7.4-8.4	Low----------	Moderate-----	Low----------	
ReC, ReD-----------	0-10	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	Moderate-----	Low----------	6
Reliance	10-28	0.2-0.6	0.11-0.19	6.6-7.8	High---------	High---------	Low----------	
	28-50	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	High---------	Low----------	
	50-60	2.0-6.0	0.14-0.16	7.4-8.4	Low----------	Low----------	Low----------	
RfC----------------	0-10	0.2-0.6	0.19-0.22	6.1-7.3	Moderate-----	Moderate-----	Low----------	7
Reliance	10-28	0.2-0.6	0.11-0.19	6.6-7.8	High---------	High---------	Low----------	
	28-60	0.2-2.0	0.17-0.20	7.4-8.4	Moderate-----	High---------	Low----------	
Rw*.								
Riverwash								
SaG----------------	0-16	0.06-0.2	0.08-0.12	6.6-8.4	High---------	High---------	Moderate-----	8
Sansarc	16-60	---	---	---	-------------	-------------	-------------	
Sc-----------------	0-8	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	High---------	Low----------	6
Scott	8-48	<0.06	0.11-0.13	6.6-7.8	High---------	High---------	Low----------	
	48-56	0.2-0.6	0.18-0.20	6.6-7.8	High---------	High---------	Low----------	
	56-64	0.6-2.0	0.20-0.22	7.4-7.8	Moderate-----	High---------	Low----------	

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Shrink-swell potential	Risk of corrosion		Wind erodi-bility group
						Uncoated steel	Concrete	
	In	In/hr	In/in	pH				
Sm	0-5	6.0-20	0.10-0.12	6.1-7.3	Low	Low	Low	2
Simeon	5-60	6.0-20	0.03-0.05	6.1-7.3	Low	Low	Low	
SuC*:								
Simeon	0-5	6.0-20	0.10-0.12	6.1-7.3	Low	Low	Low	2
	5-60	6.0-20	0.03-0.05	6.1-7.3	Low	Low	Low	
Valentine	0-11	6.0-20	0.08-0.11	6.1-7.3	Low	Low	Low	2
	11-60	6.0-20	0.06-0.08	6.1-7.3	Low	Low	Low	
SvF2*:								
Simeon	0-5	6.0-20	0.10-0.12	6.1-7.3	Low	Low	Low	2
	5-60	6.0-20	0.03-0.05	6.1-7.3	Low	Low	Low	
Valentine	0-11	6.0-20	0.08-0.11	6.1-7.3	Low	Low	Low	1
	11-60	6.0-20	0.06-0.08	6.1-7.3	Low	Low	Low	
VaE	0-11	6.0-20	0.08-0.11	6.1-7.3	Low	Low	Low	1
Valentine	11-60	6.0-20	0.06-0.08	6.1-7.3	Low	Low	Low	
VbB	0-11	6.0-20	0.08-0.11	6.1-7.3	Low	Low	Low	2
Valentine	11-60	6.0-20	0.06-0.08	6.1-7.3	Low	Low	Low	
Ve	0-14	0.06-0.2	0.12-0.15	6.1-7.3	High	High	Low	4
Verdel	14-60	<0.2	0.09-0.14	6.6-9.0	High	High	Low	
WeC	0-8	2.0-6.0	0.14-0.17	6.1-7.3	Low	Low	Low	3
Wewela	8-15	0.6-2.0	0.16-0.18	6.1-7.3	Moderate	Moderate	Low	
	15-22	0.06-0.2	0.08-0.12	6.1-7.8	High	High	Moderate	
	22-60	---	---	---	---	---	---	

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
Ab----------------- Albaton	D	Occasional	Brief-----	Mar-Jun	1.0-3.0	Perched---	Nov-May	>60	---
AnC, AnD, AnF----- Anselmo	A	None--------	---	---	>6.0	---	---	>60	---
ArF*: Anselmo----------	A	None--------	---	---	>6.0	---	---	>60	---
Rock outcrop.									
Ba----------------- Barney	D	Frequent----	Long------	Mar-Jun	0-2.0	Apparent	Nov-Jun	>60	---
Bd----------------- Blake	C	Occasional	Very brief	Mar-Jun	2.0-4.0	Apparent	Nov-May	>60	---
Be, BeC----------- Blendon	A	None--------	---	---	>6.0	---	---	>60	---
BoD--------------- Boyd	D	None--------	---	---	>6.0	---	---	20-40	Rippable
BrG--------------- Bristow	D	None--------	---	---	>6.0	---	---	10-20	Rippable
Bs, Bt------------ Brocksburg	B	None--------	---	---	>6.0	---	---	>60	---
Cb----------------- Cass	B	Occasional	Brief-----	Mar-Jun	>6.0	---	---	>60	---
CrE2-------------- Crofton	B	None--------	---	---	>6.0	---	---	>60	---
DuB, DuC, DuD, DxB-------------- Dunday	A	None--------	---	---	>6.0	---	---	>60	---
Et----------------- Eltree	B	None--------	---	---	>6.0	---	---	>60	---
Go, GrB----------- Grigston	B	Occasional to frequent.	Very brief	Apr-Sep	>6.0	---	---	>60	---
Ha----------------- Hall	B	None--------	---	---	>6.0	---	---	>60	---
He----------------- Haynie	B	Occasional	Very brief	Mar-Jun	>6.0	---	---	>60	---
IfD, IgB, IhB, In- Inavale	A	Rare to frequent.	Very brief	Jan-Jul	>6.0	---	---	>60	---
Jn, JnC, JnD------ Jansen	B	None--------	---	---	>6.0	---	---	>60	---
LaD--------------- Labu	D	None--------	---	---	>6.0	---	---	20-40	Rippable
LcF*: Labu--------------	D	None--------	---	---	>6.0	---	---	20-40	Rippable

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
LcF*:									
Sansarc	D	None	---	---	>6.0	---	---	4-20	Rippable
Le Leshara	B	Occasional	Very brief	Mar-Jul	1.5-3.0	Apparent	Nov-Jul	>60	---
LsC, LsD Lynch	D	None	---	---	>6.0	---	---	20-40	Rippable
LyD*, LyF*:									
Lynch	D	None	---	---	>6.0	---	---	20-40	Rippable
Bristow	D	None	---	---	>6.0	---	---	10-20	Rippable
MaG*:									
Mariaville	D	None	---	---	>6.0	---	---	10-20	Rippable
Paka	B	None	---	---	>6.0	---	---	40-60	Rippable
MeE Meadin	A	None	---	---	>6.0	---	---	>60	---
NoC, NoD Nora	B	None	---	---	>6.0	---	---	>60	---
Oa Onawa	D	Occasional	Brief	Mar-Jun	2.0-4.0	Apparent	Nov-May	>60	---
Oe, OeC O'Neill	B	None	---	---	>6.0	---	---	>60	---
OfD*:									
O'Neill	B	None	---	---	>6.0	---	---	>60	---
Meadin	A	None	---	---	>6.0	---	---	>60	---
On Onita	C	None	---	---	>6.0	---	---	---	---
Or Ord	B	Occasional	Brief	Mar-May	1.5-3.5	Apparent	Nov-May	>60	---
PaC, Ph, PhC, PhD Paka	B	None	---	---	>6.0	---	---	40-60	Rippable
PoC Promise	D	None to rare	---	---	>6.0	---	---	>60	---
RaC, RaD, RaE Ree	B	None	---	---	>6.0	---	---	>60	---
ReC, ReD, RfC Reliance	C	None	---	---	>6.0	---	---	>60	---
Rw*. Riverwash									
SaG Sansarc	D	None	---	---	>6.0	---	---	4-20	Rippable
Sc Scott	D	Frequent	Long to very long.	Mar-Aug	+.5-1.0	Perched	Mar-Aug	>60	---
Sm Simeon	A	None	---	---	>6.0	---	---	>60	---

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
SuC*, SvF2*:									
Simeon-----------	A	None--------	---	---	>6.0	---	---	>60	---
Valentine--------	A	None--------	---	---	>6.0	---	---	>60	---
VaE, VbB---------- Valentine	A	None--------	---	---	>6.0	---	---	>60	---
Ve---------------- Verdel	D	None--------	---	---	>6.0	---	---	>60	---
WeC--------------- Wewela	B	None--------	---	---	>6.0	---	---	20-40	Rippable

* See map unit description for the composition and behavior of the map unit.

TABLE 17.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic. TR means trace.]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution										LL	PI	Particle density
			Percentage passing sieve							Percentage smaller than--					
	AASHTO	Unified	2 inch	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm	Pct		G/CC
Anselmo fine sandy loam: (S72NE-008-017)															
A1------ 0 to 11	A-4 (1)	SM	100	100	100	100	100	96	41	22	10	8	23	2	2.63
B21----- 11 to 16	A-2-4 (0)	SM	100	100	100	100	99	96	31	17	9	8	18	NP	2.63
C------- 30 to 60	A-2-4(<2)	SM	100	100	100	100	100	95	13	3	2	2	--	NP	2.65
Boyd silty clay: (S76NE-015-005)															
A1------ 0 to 6	A-7-5(26)	MH	100	100	100	100	100	98	93	82	57	46	73	38	2.60
B2------ 10 to 20	A-7-5(26)	CH	100	100	100	100	100	99	97	94	69	58	71	39	2.70
C1------ 20 to 32	A-7-6(32)	CH	100	100	100	100	100	100	98	95	73	60	79	50	2.75
Bristow silty clay: (S76NE-015-003)															
A1------ 0 to 7	A-7-5(22)	MH	100	100	100	100	100	99	99	94	74	60	65	32	2.73
Brocksburg loam: (S72NE-008-025)															
Ap------ 0 to 6	A-4 (4)	CL-ML	100	100	99	99	96	77	57	32	16	13	27	7	2.61
B22t---- 19 to 28	A-7-6(17)	CL	100	100	99	98	97	88	80	58	38	33	49	27	2.68
IIC----- 32 to 60	A-3 (<3)	SP-SM	100	99	99	97	93	59	7	4	2	2	--	NP	2.65
Dunday loamy fine sand: (S72NE-008-020)															
Ap------ 0 to 7	A-2-4 (0)	SM	100	100	100	100	100	91	32	17	9	8	16	NP	2.63
Ac------ 14 to 24	A-2-4(<1)	SM	100	100	100	100	100	86	21	14	10	9	16	NP	2.65
C2------ 30 to 60	A-3 (<2)	SP-SM	100	100	100	100	100	92	10	7	5	5	--	NP	2.66
Eltree silt loam: (S72NE-008-003)															
Ap------ 0 to 7	A-4 (8)	ML	100	100	100	100	100	100	97	34	17	14	34	8	2.63
B21t---- 13 to 23	A-4 (8)	ML	100	100	100	100	100	100	98	42	22	16	36	10	2.66
C1------ 32 to 48	A-6 (10)	CL	100	100	100	100	100	100	99	58	34	27	38	15	2.67
Grigston silt loam: (S72NE-008-014)															
Ap------ 0 to 7	A-7-6(15)	CL	100	100	100	100	100	100	91	70	43	37	48	24	2.64
B2------ 15 to 22	A-7-6(16)	CL	100	100	100	100	100	100	94	60	37	31	48	26	2.68
C2------ 31 to 54	A-6 (3)	SC	100	100	100	100	100	97	46	32	19	17	26	11	2.66
Labu silty clay: (S72NE-008-023)															
A1------ 0 to 5	A-7-5(27)	CH	100	100	100	100	100	99	97	88	67	56	73	42	2.69
Cr------ 31 to 60	A-7-6(31)	CH	100	100	100	100	100	100	94	85	65	52	77	48	2.86

TABLE 17.--ENGINEERING TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution										LL	PI	Particle density
			Percentage passing sieve							Percentage smaller than--					
	AASHTO	Unified	2 inch	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm	Pct		G/CC
Labu silty clay: (S76NE-015-001)															
A1------ 0 to 6	A-7-5(21)	MH	100	100	100	100	99	97	94	80	56	44	67	28	2.63
B22----- 14 to 25	A-7-6(28)	CH	100	100	100	100	100	98	96	91	66	50	73	44	2.72
Lynch silty clay: (S72NE-008-022)															
Ap------ 0 to 5	A-7-5(20)	CH	100	100	100	100	100	99	94	74	53	41	61	30	2.61
B2------ 14 to 28	A-7-6(22)	CH	100	100	100	100	100	100	98	95	82	66	62	33	2.71
C------- 28 to 36	A-7-6(13)	CL	100	100	100	100	100	96	70	61	48	40	49	22	3.06
Lynch silty clay: (S76NE-015-004)															
Ap------ 0 to 4	A-7-5(18)	MH	100	100	100	100	100	99	94	78	57	42	57	26	2.62
B2------ 14 to 28	A-7-6(21)	CH	100	100	100	100	100	100	98	95	83	64	60	32	2.71
C1------ 28 to 33	A-7-6(24)	CH	100	100	100	100	100	100	99	98	88	69	65	37	2.74
Onita silt loam: (S72NE-008-019)															
A1p----- 0 to 6	A-7-6(11)	CL	100	100	100	100	100	99	94	52	31	25	42	17	2.61
B22t---- 22 to 32	A-7-6(20)	CH	100	100	100	100	100	100	98	69	48	40	55	33	2.70
Cca----- 40 to 60	A-7-6(16)	CL	100	100	100	100	100	99	95	59	40	32	46	27	2.71
Reliance silty clay loam: (S72NE-008-007)															
Ap------ 0 to 7	A-7-6(13)	CL	100	100	100	100	100	99	97	61	39	34	45	21	2.66
B22t---- 14 to 23	A-7-6(21)	CH	100	100	100	100	100	100	99	66	44	38	56	34	2.70
C1------ 34 to 38	A-7-6(20)	CH	100	100	100	100	100	99	96	66	47	38	53	33	2.73
Sansarc silty clay: (S76NE-015-006)															
A1------ 0 to 5	A-7-6(27)	CH	100	100	100	100	100	98	88	82	64	52	74	40	2.68
Cr1----- 11 to 16	A-7-5(32)	CH	100	100	100	100	100	98	92	90	76	67	92	58	2.76
Valentine fine sand: (S72NE-008-024)															
A1------ 0 to 5	A-2-4(<2)	SP-SM	100	100	100	100	100	89	11	8	5	4	--	NP	2.62
C2------ 18 to 60	A-3 (<2)	SP-SM	100	100	100	100	100	92	6	4	3	3	--	NP	2.67
Verdel silty clay: (S76NE-015-002)															
A12----- 7 to 14	A-7-6(19)	CH	100	100	100	100	100	99	93	79	57	46	57	30	2.69
B22----- 28 to 40	A-7-6(24)	CH	100	100	100	100	99	96	89	77	53	44	60	36	2.74
C------- 40 to 60	A-7-6(22)	CH	100	100	100	100	99	98	93	77	54	45	62	38	2.71

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Albaton	Fine, montmorillonitic (calcareous), mesic Vertic Fluvaquents
Anselmo	Coarse-loamy, mixed, mesic Typic Haplustolls
Barney	Sandy, mixed, mesic Mollic Fluvaquents
Blake	Fine-silty, mixed (calcareous), mesic Aquic Udifluvents
Blendon	Coarse-loamy, mixed, mesic Pachic Haplustolls
Boyd	Fine, montmorillonitic, mesic Vertic Haplustolls
Bristow	Clayey, mixed (calcareous), mesic, shallow Typic Ustorthents
Brocksburg	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Pachic Argiustolls
Cass	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Crofton	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Dunday	Sandy, mixed, mesic Entic Haplustolls
Eltree	Fine-silty, mixed, mesic Pachic Haplustolls
Grigston	Fine-silty, mixed, mesic Fluventic Haplustolls
Hall	Fine-silty, mixed, mesic Pachic Argiustolls
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Jansen	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Argiustolls
Labu	Fine, montmorillonitic, mesic Vertic Ustochrepts
*Leshara	Fine-silty, mixed, mesic Typic Haplaquolls
Lynch	Fine, mixed, mesic Typic Ustochrepts
Mariaville	Loamy, mixed (calcareous), mesic shallow Typic Ustorthents
Meadin	Sandy-skeletal, mixed, mesic Entic Haplustolls
Nora	Fine-silty, mixed, mesic Udic Haplustolls
O'Neill	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplustolls
Onawa	Clayey over loamy, montmorillonitic (calcareous), mesic Mollic Fluvaquents
Onita	Fine, montmorillonitic, mesic Pachic Argiustolls
Ord	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Paka	Fine-silty, mixed, mesic Typic Argiustolls
Promise	Very-fine, montmorillonitic, mesic Vertic Haplustolls
Ree	Fine-loamy, mixed, mesic Typic Argiustolls
Reliance	Fine, montmorillonitic, mesic Typic Argiustolls
Sansarc	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Ustorthents
Scott	Fine, montmorillonitic, mesic Typic Argialbolls
Simeon	Mixed, mesic Typic Ustipsamments
Valentine	Mixed, mesic Typic Ustipsamments
Verdel	Fine, montmorillonitic, mesic Vertic Haplustolls
Wewela	Fine-loamy, mixed, mesic Typic Argiustolls

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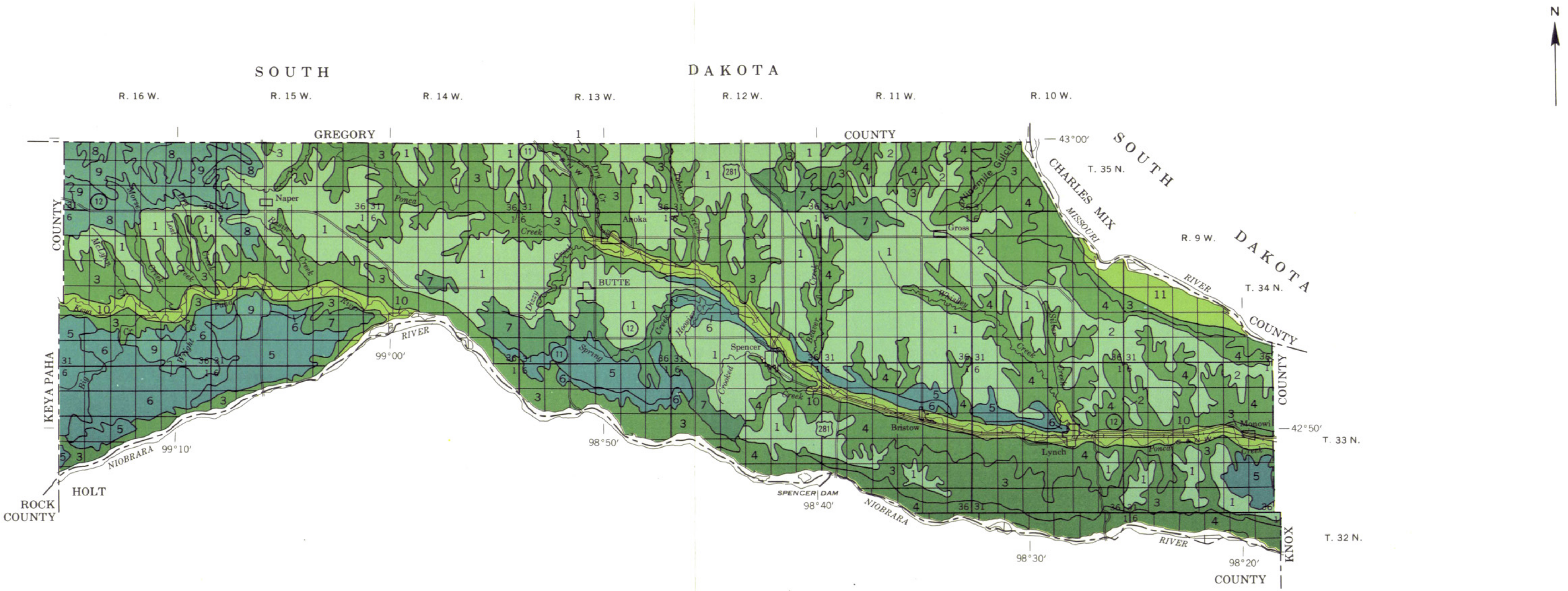


SOIL ASSOCIATIONS

SILTY SOILS ON UPLANDS

1 — Onita–Reliance–Ree association: Deep, nearly level to strongly sloping, well drained and moderately well drained silty soils formed in loess

2 — Nora–Crofton–Eltree association: Deep, nearly level to moderately steep, well drained silty soils formed in loess

CLAYEY SOILS ON UPLANDS

3 — Labu–Sansarc association: Moderately deep and shallow, strongly sloping to very steep, well drained clayey soils formed in residuum from shale

4 — Bristow–Lynch association: Shallow and moderately deep, gently sloping to very steep, well drained and excessively drained clayey soils formed in residuum from calcareous and gypsiferous chalky shale

SANDY SOILS ON UPLANDS

5 — Dunday–Valentine–Simeon association: Deep, nearly level to moderately steep, well drained and excessively drained sandy soils formed in windblown and outwash sands and gravelly sands

6 — Valentine–Simeon association: Deep, nearly level to steep, excessively drained sandy soils formed in windblown and outwash sands and gravelly sands

LOAMY AND SANDY SOILS ON UPLANDS

7 — Anselmo–Dunday–Blendon association: Deep, nearly level to moderately steep, well drained loamy and sandy soils formed in windblown sandy material

LOAMY SOILS ON UPLANDS UNDERLAIN BY SAND AND GRAVEL

8 — Meadin–Jansen–O'Neill association: Nearly level to moderately steep, well drained and excessively drained loamy soils that are shallow or moderately deep over sand and gravel; on upland divides and along drainageways

9 — Brocksburg–Jansen association: Nearly level to gently sloping, well drained loamy soils that are moderately deep over sand and gravel; on uplands

SOILS ON BOTTOM LANDS

10 — Inavale–Grigston–Cass association: Deep, nearly level to strongly sloping, well drained and somewhat excessively drained sandy, loamy, and silty soils formed in alluvial deposits

11 — Haynie–Albaton–Onawa association: Deep, nearly level, moderately well drained to poorly drained silty and clayey soils formed in recent alluvial deposits

Compiled 1978

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP

BOYD COUNTY, NEBRASKA

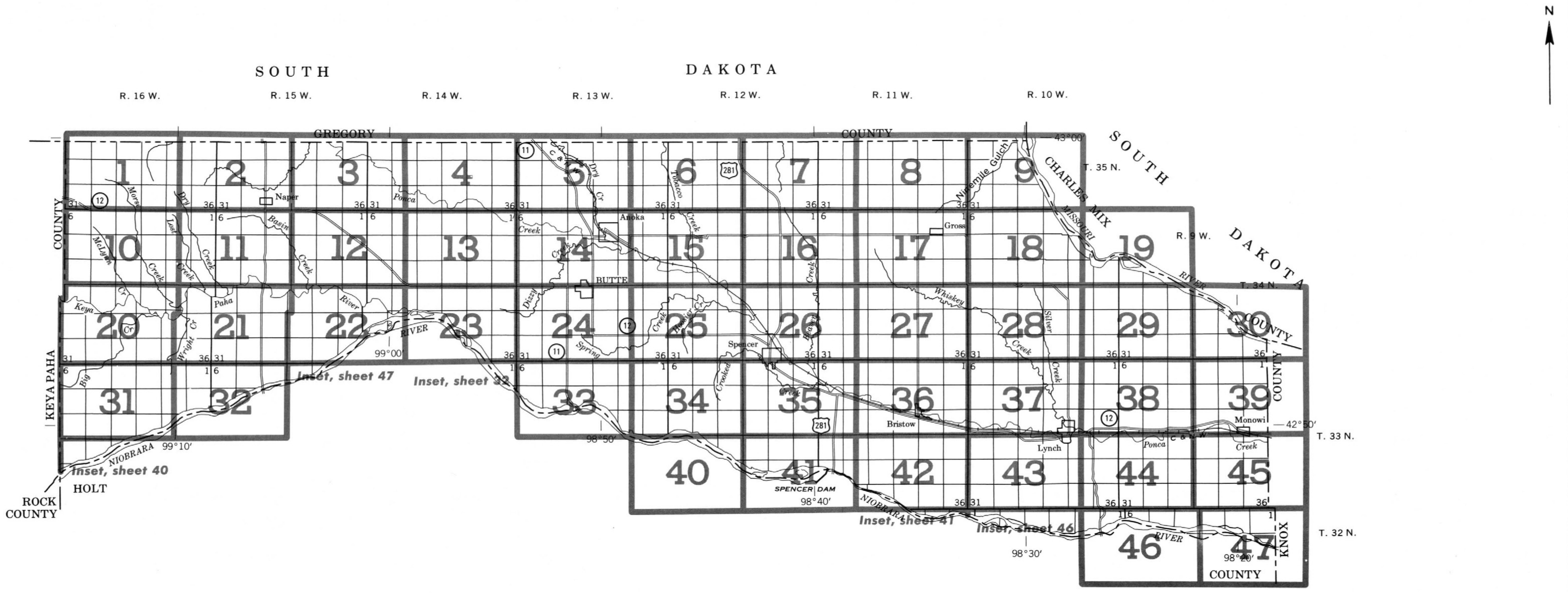
Scale 1:253,440

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

BOYD COUNTY, NEBRASKA

Scale 1:253,440

1 0 1 2 3 4 Miles

Map Sheets #37 & #39 are out of sequence. Their order has been transposed.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL; LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — CeA; FoB2

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Gravel pit — G.P.

SOIL LEGEND

The first capital letter is the initial one of the soil name. The lower case letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are those soils with a slope range of 0 to 2 percent. A final number 2 in the symbol indicates that the soil is eroded.

SYMBOL	NAME
Ab	Albaton silty clay, 0 to 2 percent slopes
AnC	Anselmo fine sandy loam, 2 to 6 percent slopes
AnD	Anselmo fine sandy loam, 6 to 11 percent slopes
AnF	Anselmo fine sandy loam, 11 to 20 percent slopes
ArF	Anselmo—Rock outcrop complex, 11 to 20 percent slopes
Ba	Barney silt loam, 0 to 2 percent slopes
Bd	Blake silty clay loam, 0 to 2 percent slopes
Be	Blendon fine sandy loam, 0 to 2 percent slopes
BeC	Blendon fine sandy loam, 2 to 6 percent slopes
BoD	Boyd silty clay, 6 to 11 percent slopes
BrG	Bristow silty clay, 20 to 40 percent slopes
Bs	Brocksburg fine sandy loam, 0 to 2 percent slopes
Bt	Brocksburg loam, 0 to 2 percent slopes
Cb	Cass fine sandy loam, 0 to 2 percent slopes
CrE2	Crofton silt loam, 11 to 15 percent slopes, eroded
DuB	Dunday loamy fine sand, 0 to 3 percent slopes
DuC	Dunday loamy fine sand, 3 to 6 percent slopes
DuD	Dunday loamy fine sand, 6 to 11 percent slopes
DxB	Dunday loamy fine sand, loamy substratum, 0 to 3 percent slopes
Et	Eltree silt loam, 0 to 2 percent slopes
Go	Grigston silt loam, 0 to 2 percent slopes
GrB	Grigston silt loam, channeled, 0 to 3 percent slopes
Ha	Hall silt loam, 0 to 2 percent slopes
He	Haynie silt loam, 0 to 2 percent slopes
IfD	Inavale fine sand, 3 to 11 percent slopes
IgB	Inavale fine sand, channeled, 0 to 3 percent slopes
IhB	Inavale loamy fine sand, 0 to 3 percent slopes
In	Inavale fine sandy loam, 0 to 2 percent slopes
Jn	Jansen loam, 0 to 2 percent slopes
JnC	Jansen loam, 2 to 6 percent slopes
JnD	Jansen loam, 6 to 11 percent slopes
LaD	Labu silty clay, 6 to 11 percent slopes
LcF	Labu—Sansarc silty clays, 11 to 30 percent slopes
Le	Leshara silt loam, 0 to 2 percent slopes
LsC	Lynch silty clay, 2 to 6 percent slopes
LsD	Lynch silty clay, 6 to 11 percent slopes
LyD	Lynch—Bristow silty clays, 6 to 11 percent slopes
LyF	Lynch—Bristow silty clays, 11 to 30 percent slopes
MaG	Mariaville—Paka loams, 15 to 40 percent slopes
MeE	Meadin sandy loam, 3 to 17 percent slopes
NoC	Nora silt loam, 2 to 6 percent slopes
NoD	Nora silt loam, 6 to 11 percent slopes
Oa	Onawa silty clay, 0 to 2 percent slopes
Oe	O'Neill fine sandy loam, 0 to 2 percent slopes
OeC	O'Neill fine sandy loam, 2 to 6 percent slopes
OfD	O'Neill—Meadin fine sandy loams, 3 to 9 percent slopes
On	Onita silt loam, 0 to 2 percent slopes
Or	Ord fine sandy loam, 0 to 2 percent slopes
PaC	Paka fine sandy loam, 2 to 6 percent slopes
Ph	Paka loam, 0 to 2 percent slopes
PhC	Paka loam, 2 to 6 percent slopes
PhD	Paka loam, 6 to 11 percent slopes
PoC	Promise silty clay, 2 to 6 percent slopes
RaC	Ree silt loam, 2 to 6 percent slopes
RaD	Ree silt loam, 6 to 11 percent slopes
RaE	Ree silt loam, 11 to 15 percent slopes
ReC	Reliance silt loam, 2 to 6 percent slopes
ReD	Reliance silt loam, 6 to 11 percent slopes
RfC	Reliance silty clay loam, 2 to 6 percent slopes
Rw	Riverwash
SaG	Sansarc silty clay, 20 to 40 percent slopes
Sc	Scott silt loam, 0 to 1 percent slopes
Sm	Simeon loamy sand, 0 to 2 percent slopes
SuC	Simeon—Valentine loamy sands, 0 to 6 percent slopes
SvF2	Simeon—Valentine complex, 3 to 30 percent slopes, eroded
VaE	Valentine fine sand, rolling
VbB	Valentine loamy sand, 0 to 3 percent slopes
Ve	Verdel silty clay, 0 to 2 percent slopes
WeC	Wewela fine sandy loam, 2 to 6 percent slopes

BOYD COUNTY, NEBRASKA NO. 1

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BOYD COUNTY, NEBRASKA NO. 2

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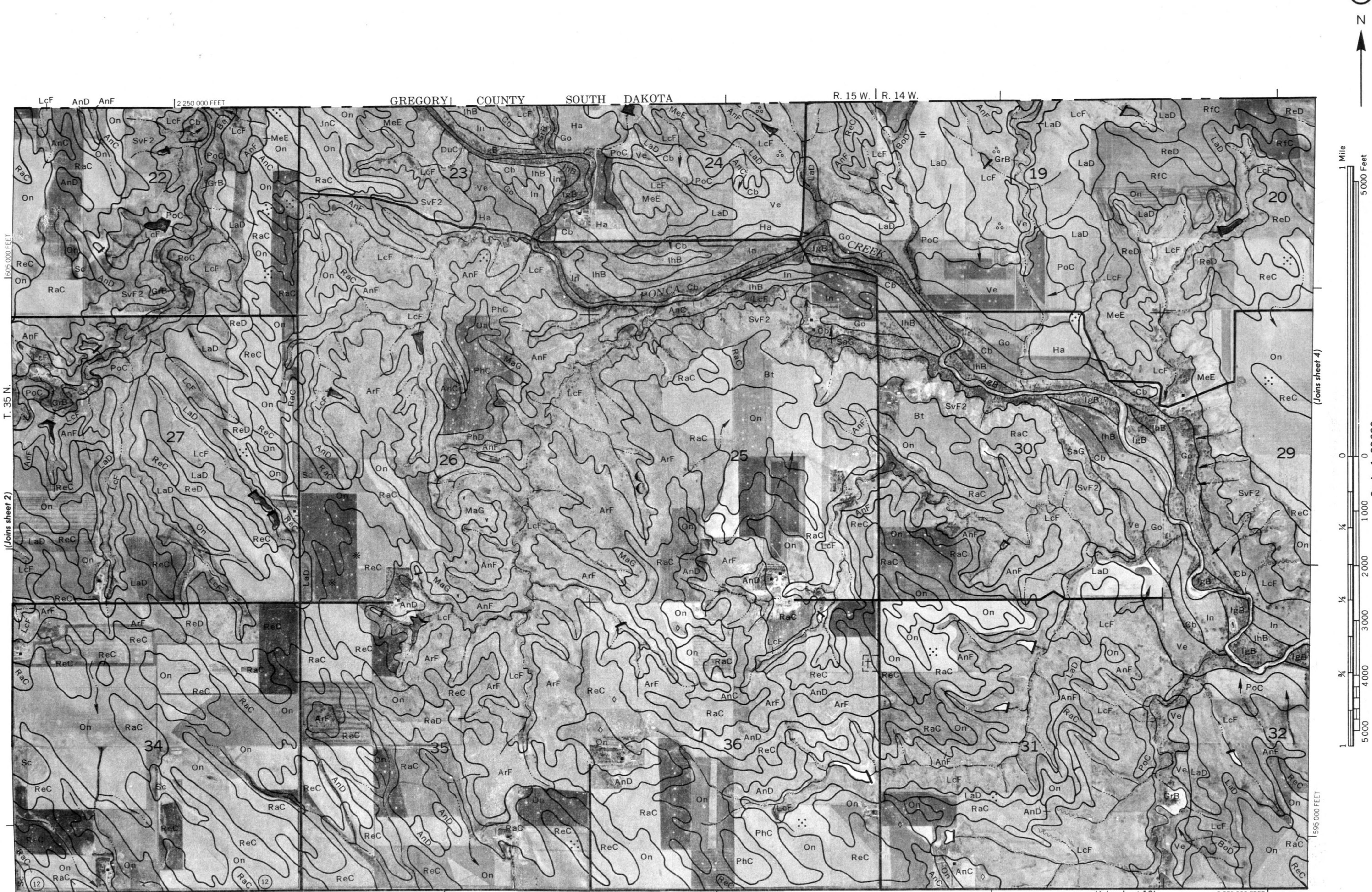

BOYD COUNTY, NEBRASKA NO. 3

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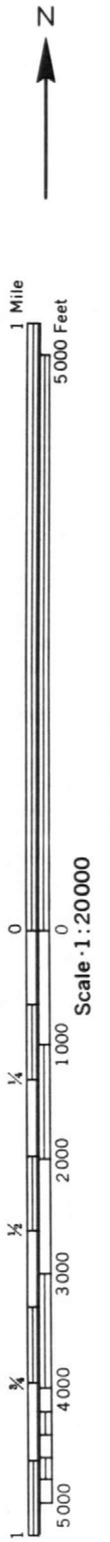
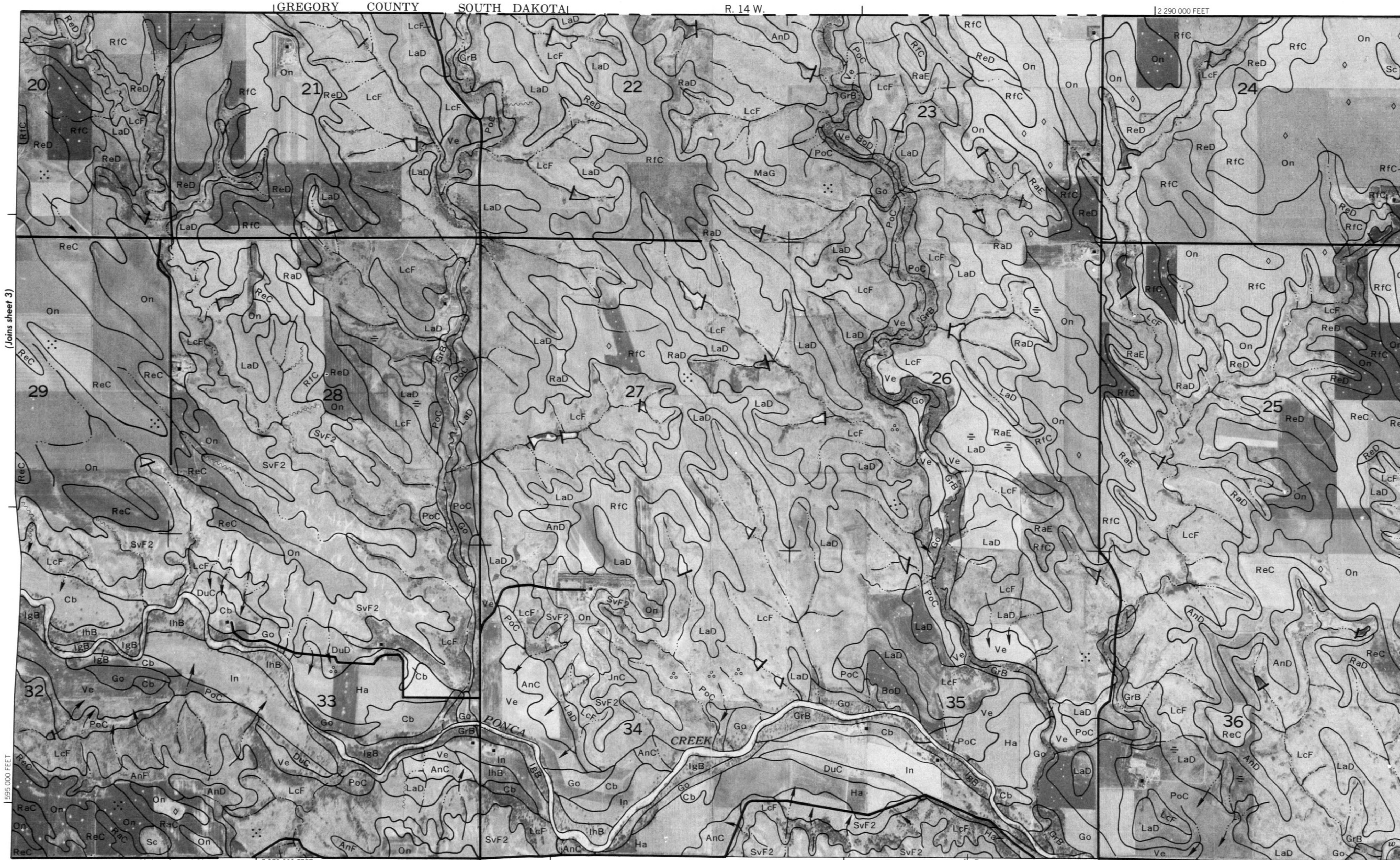
4





BOYD COUNTY, NEBRASKA NO. 4

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5

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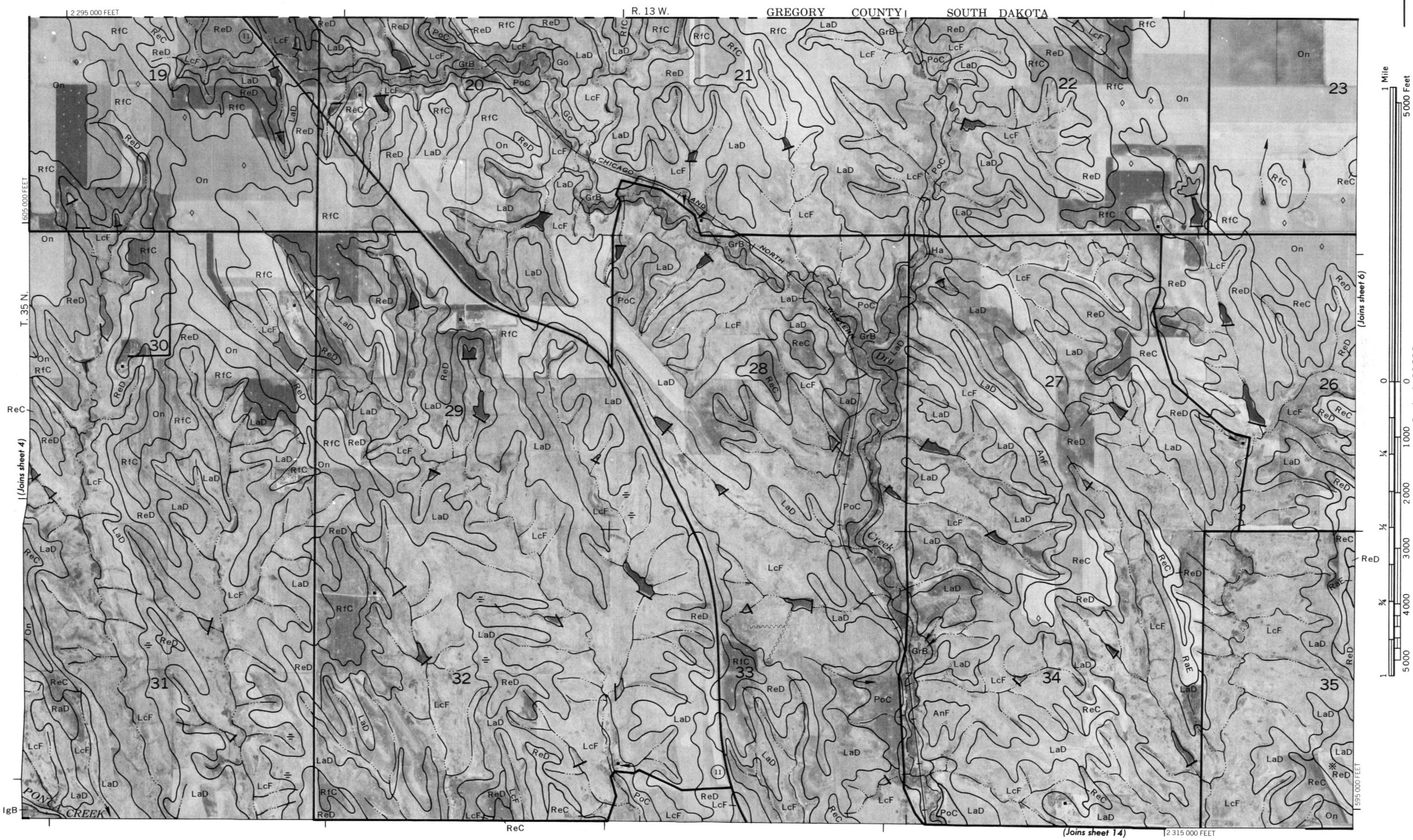
BOYD COUNTY, NEBRASKA NO. 5



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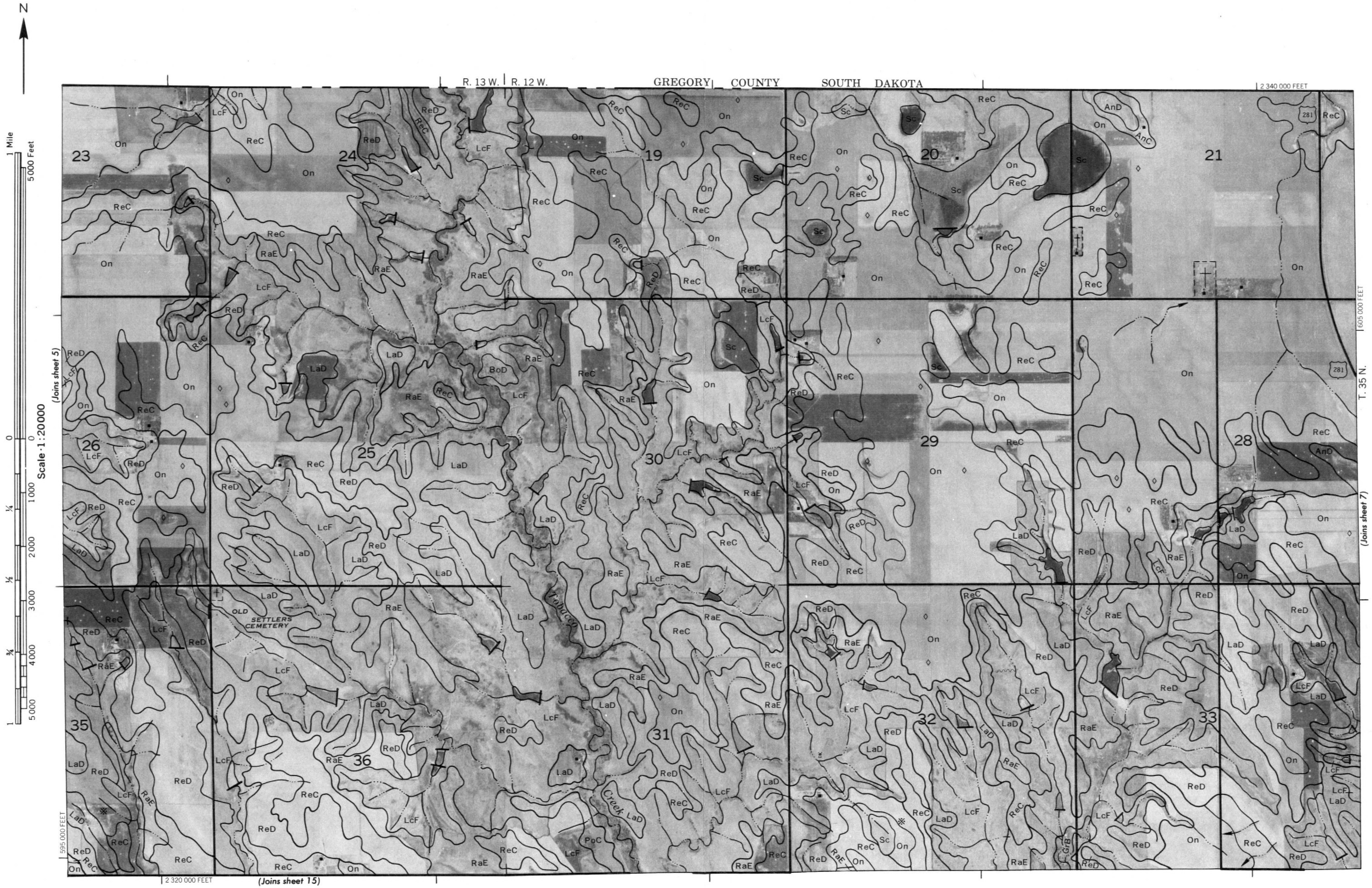

BOYD COUNTY, NEBRASKA NO. 6

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BOYD COUNTY, NEBRASKA — SHEET NUMBER 7

BOYD COUNTY, NEBRASKA NO. 7

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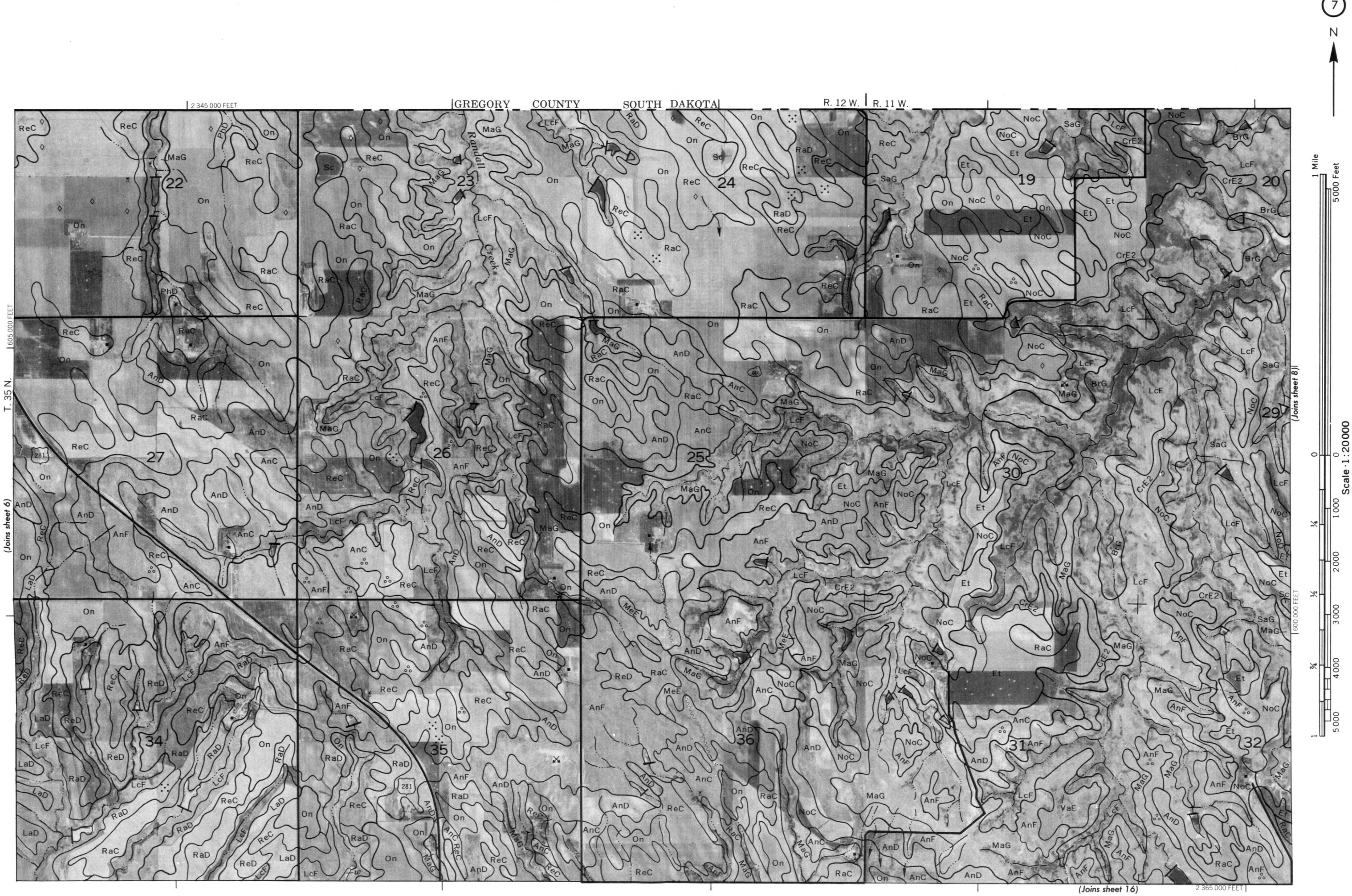
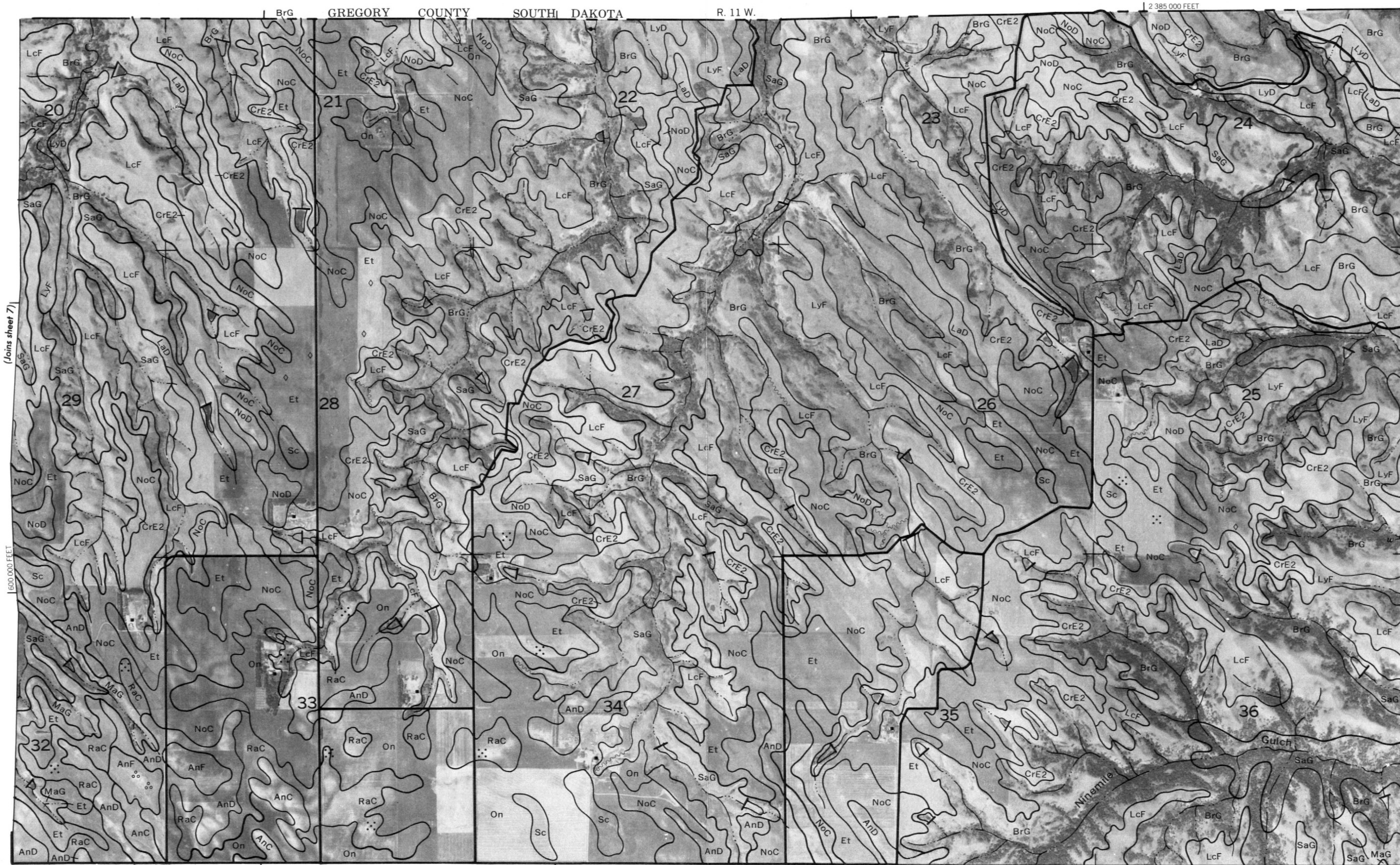


N

1 Mile
5000 Feet
Scale 1:20000



BOYD COUNTY, NEBRASKA NO. 8

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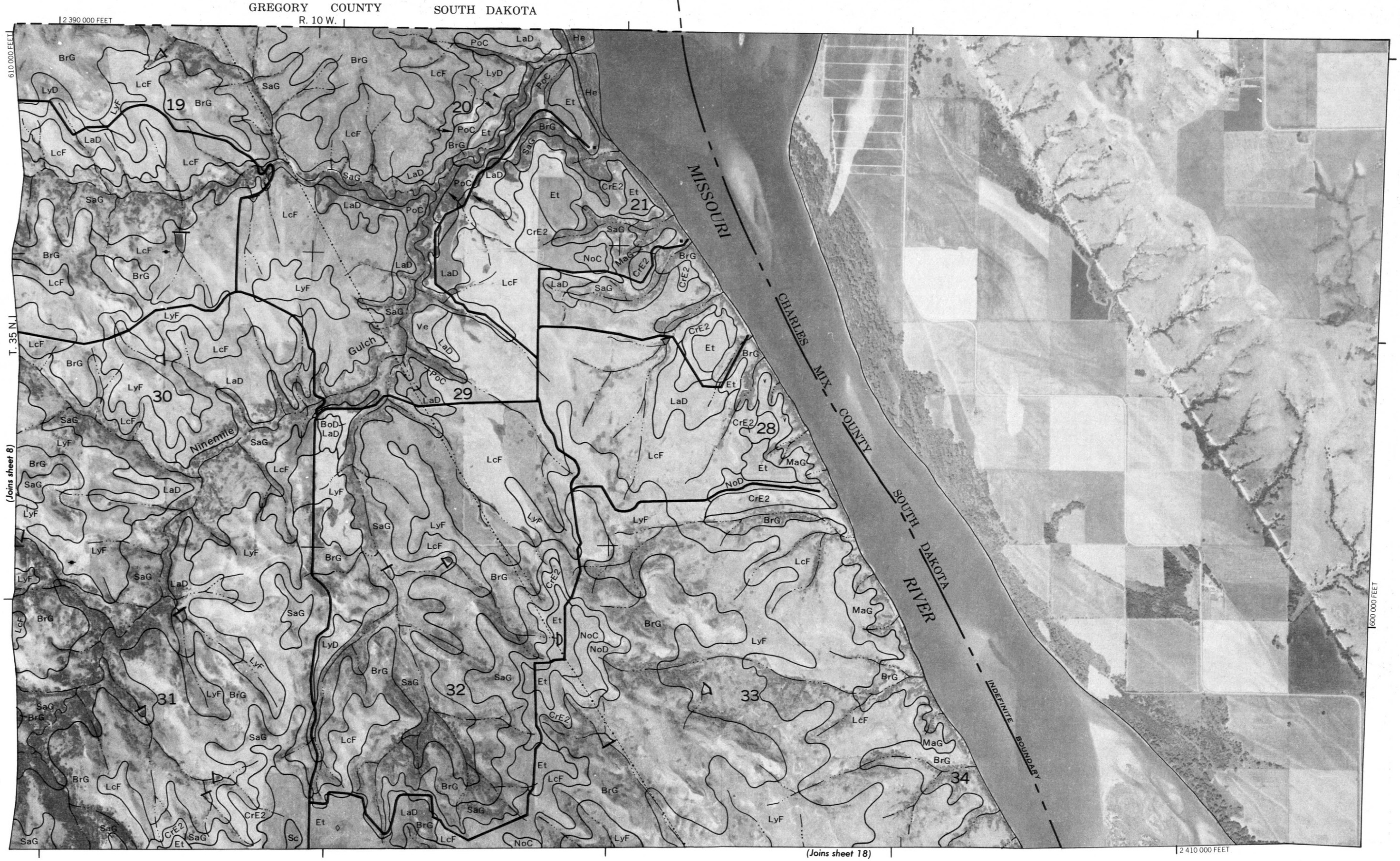
9

N



1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
1
Scale 1:20000

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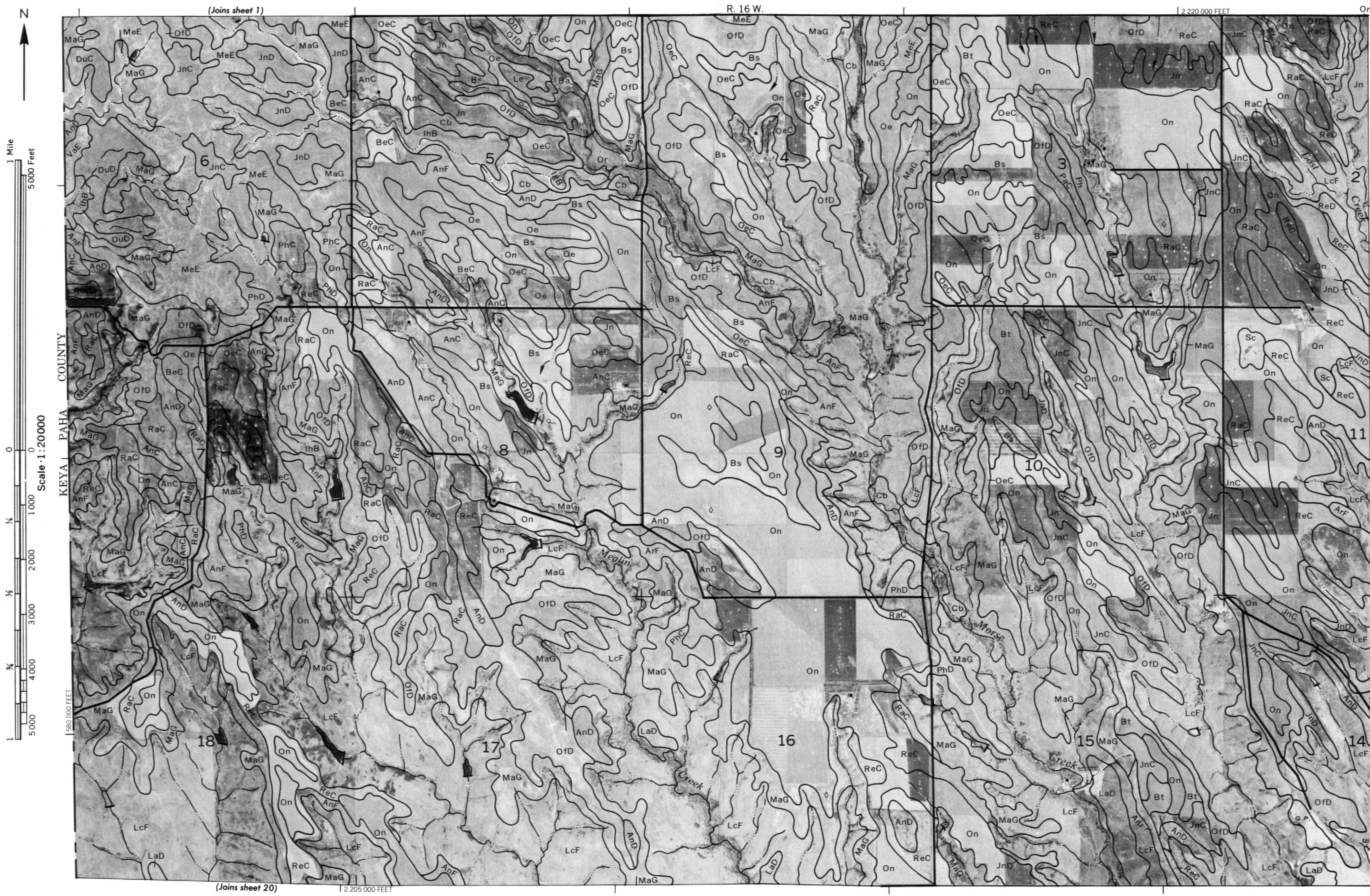
BOYD COUNTY, NEBRASKA NO. 9



BOYD COUNTY, NEBRASKA NO. 10

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BOYD COUNTY, NEBRASKA NO. 11

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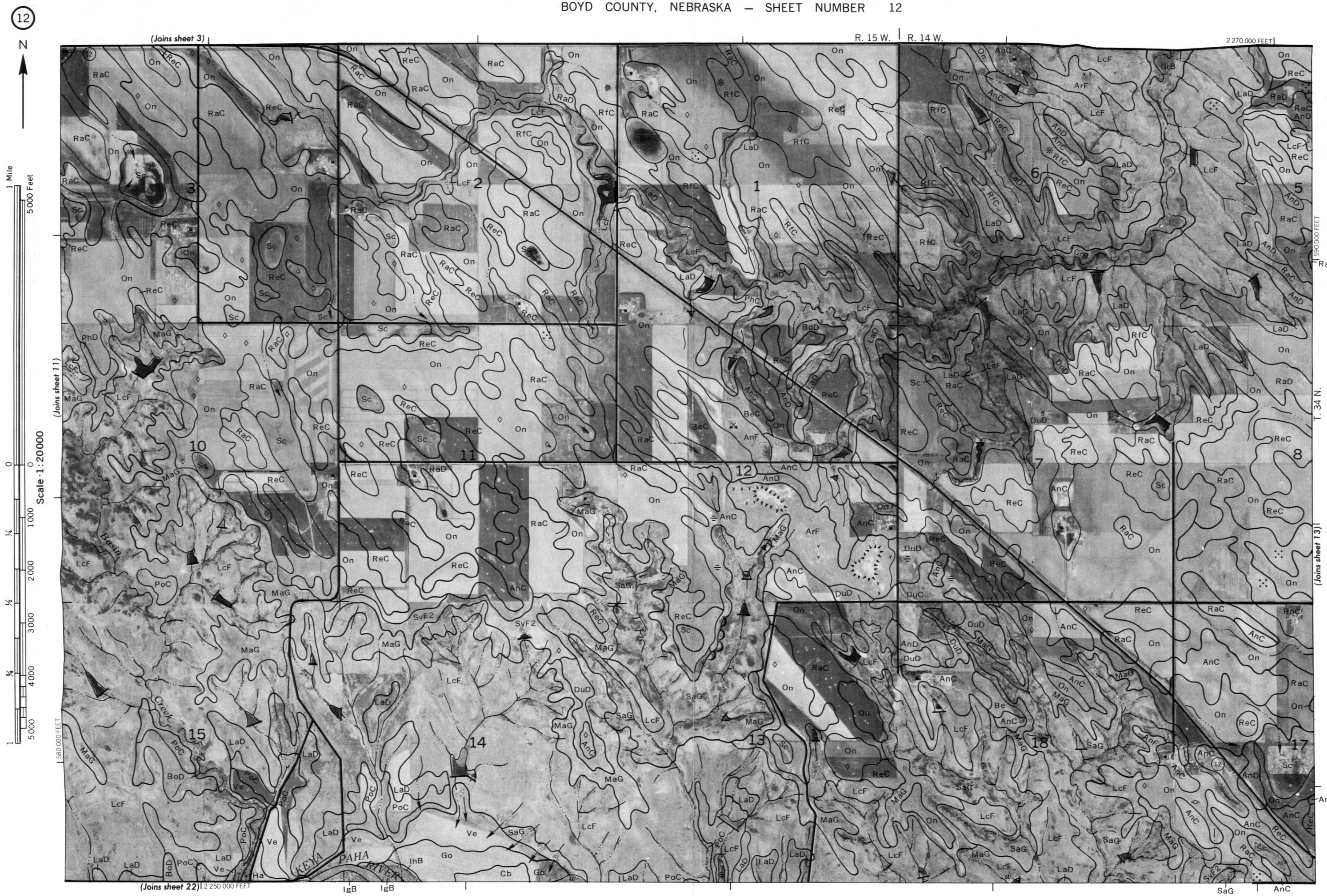

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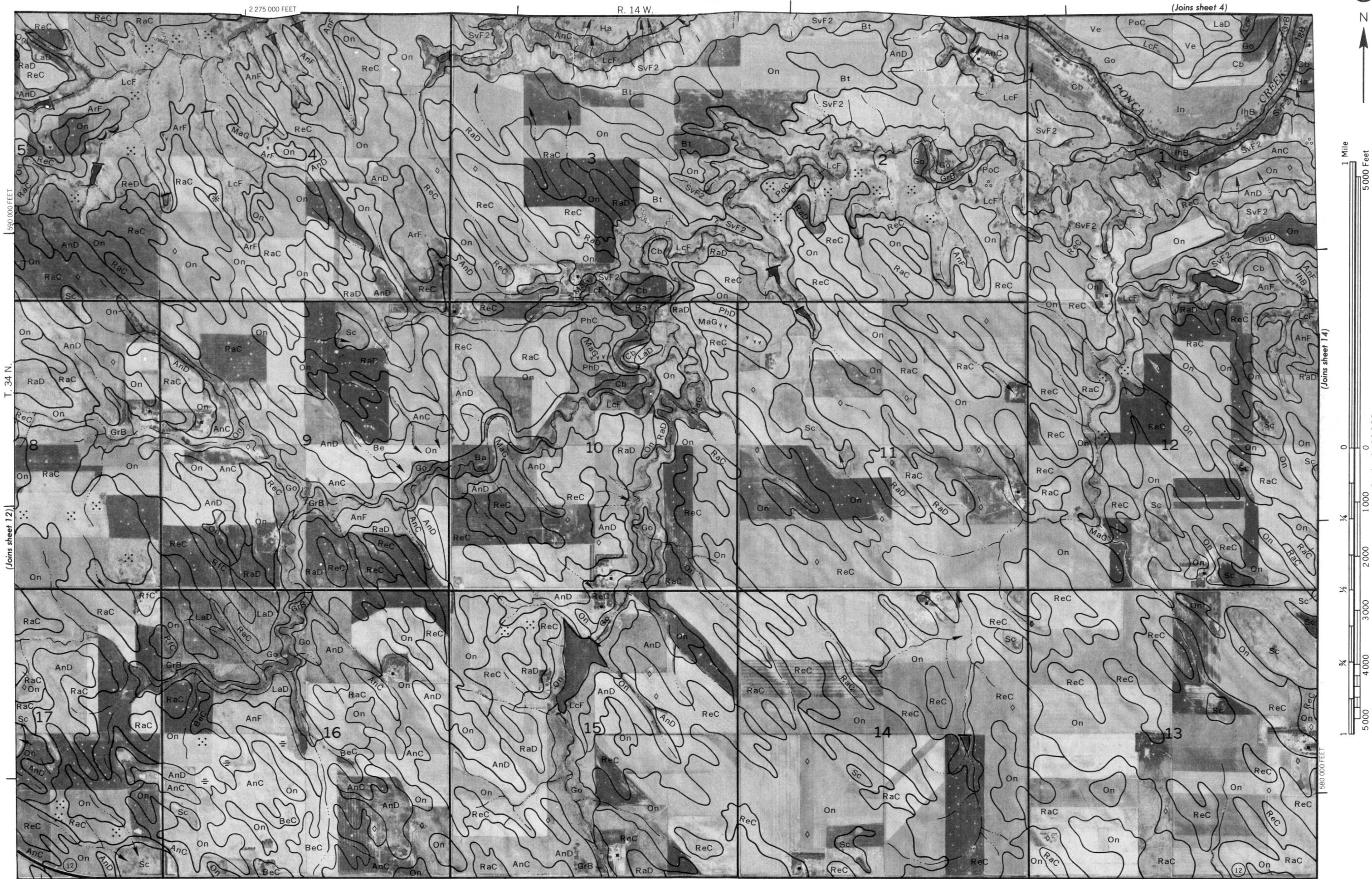

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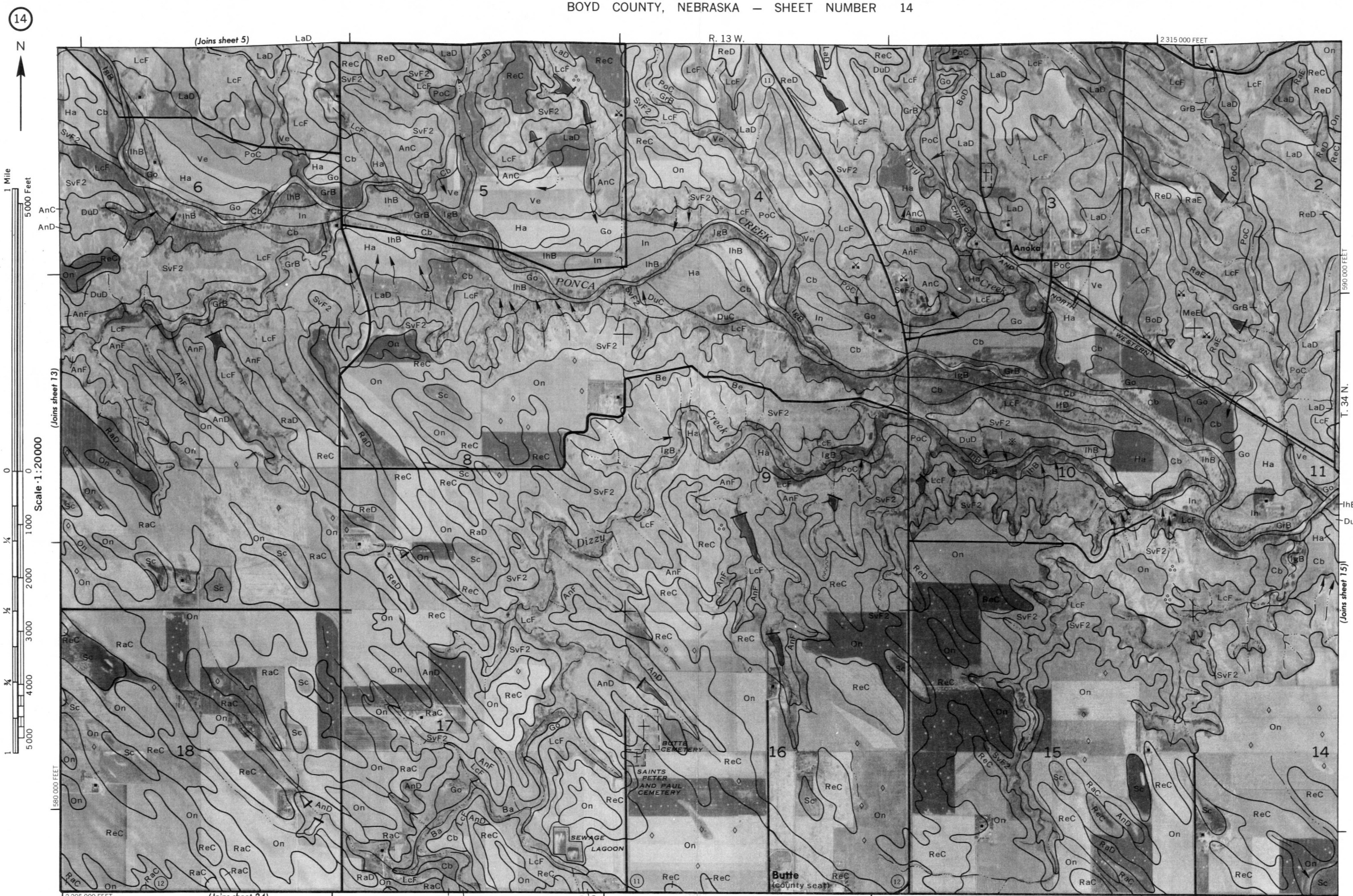
BOYD COUNTY, NEBRASKA NO. 13



BOYD COUNTY, NEBRASKA NO. 14

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BOYD COUNTY, NEBRASKA NO. 15

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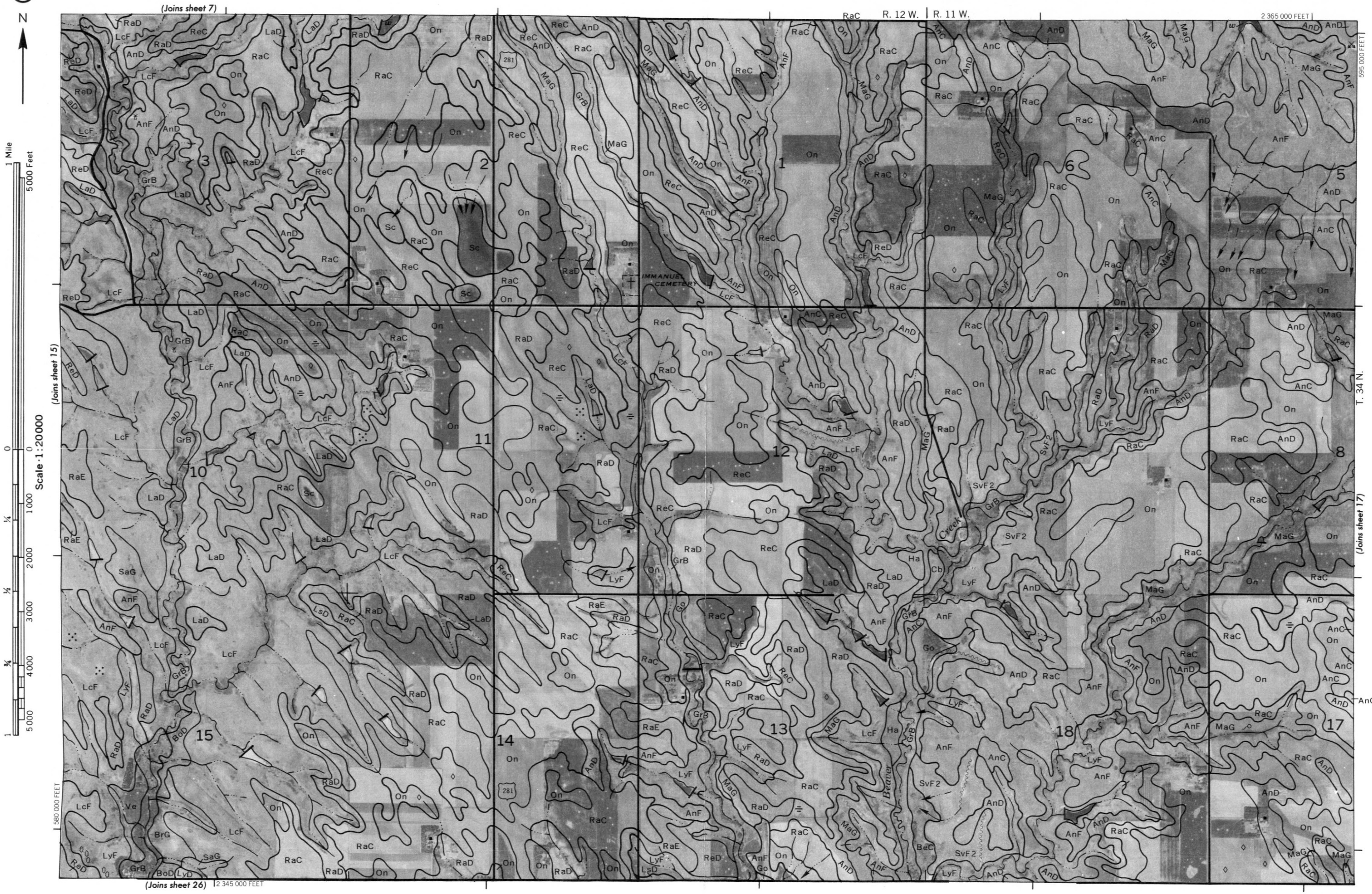
BOYD COUNTY, NEBRASKA — SHEET NUMBER 16



BOYD COUNTY, NEBRASKA NO. 16

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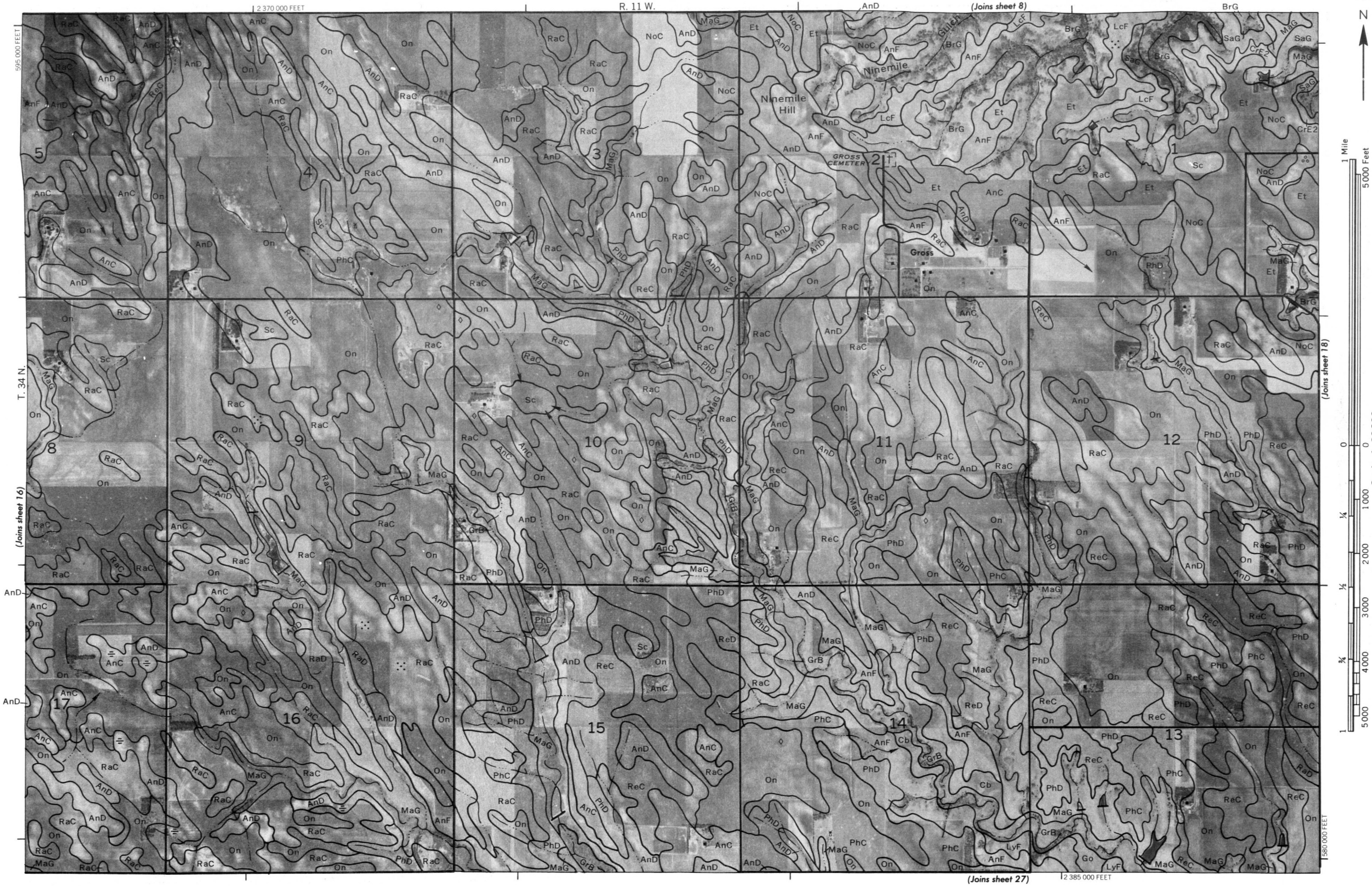
(17)



BOYD COUNTY, NEBRASKA NO. 17

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18

N

1 Mile
5000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

BOYD COUNTY, NEBRASKA NO. 18

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BOYD COUNTY, NEBRASKA NO. 19

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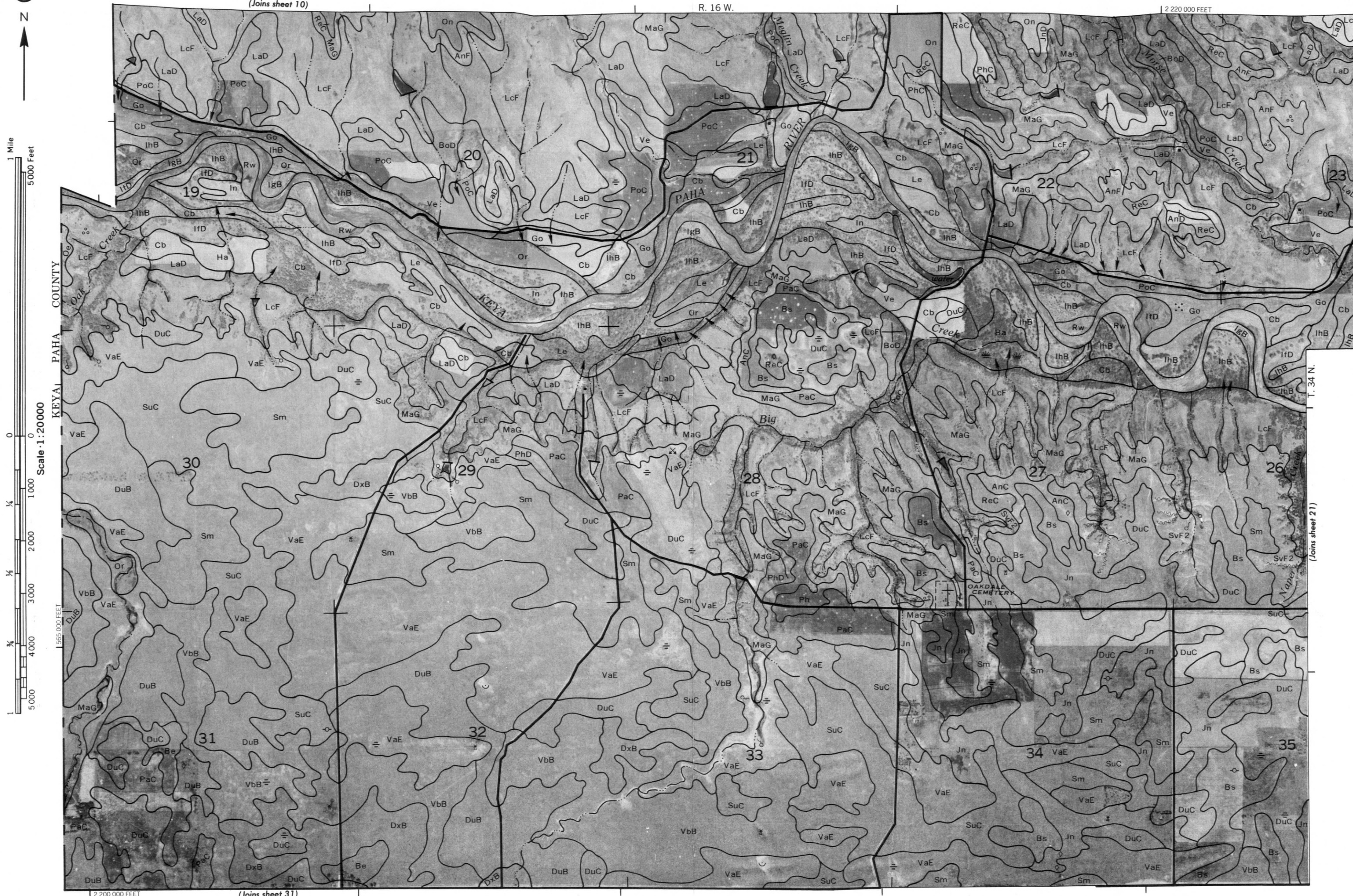

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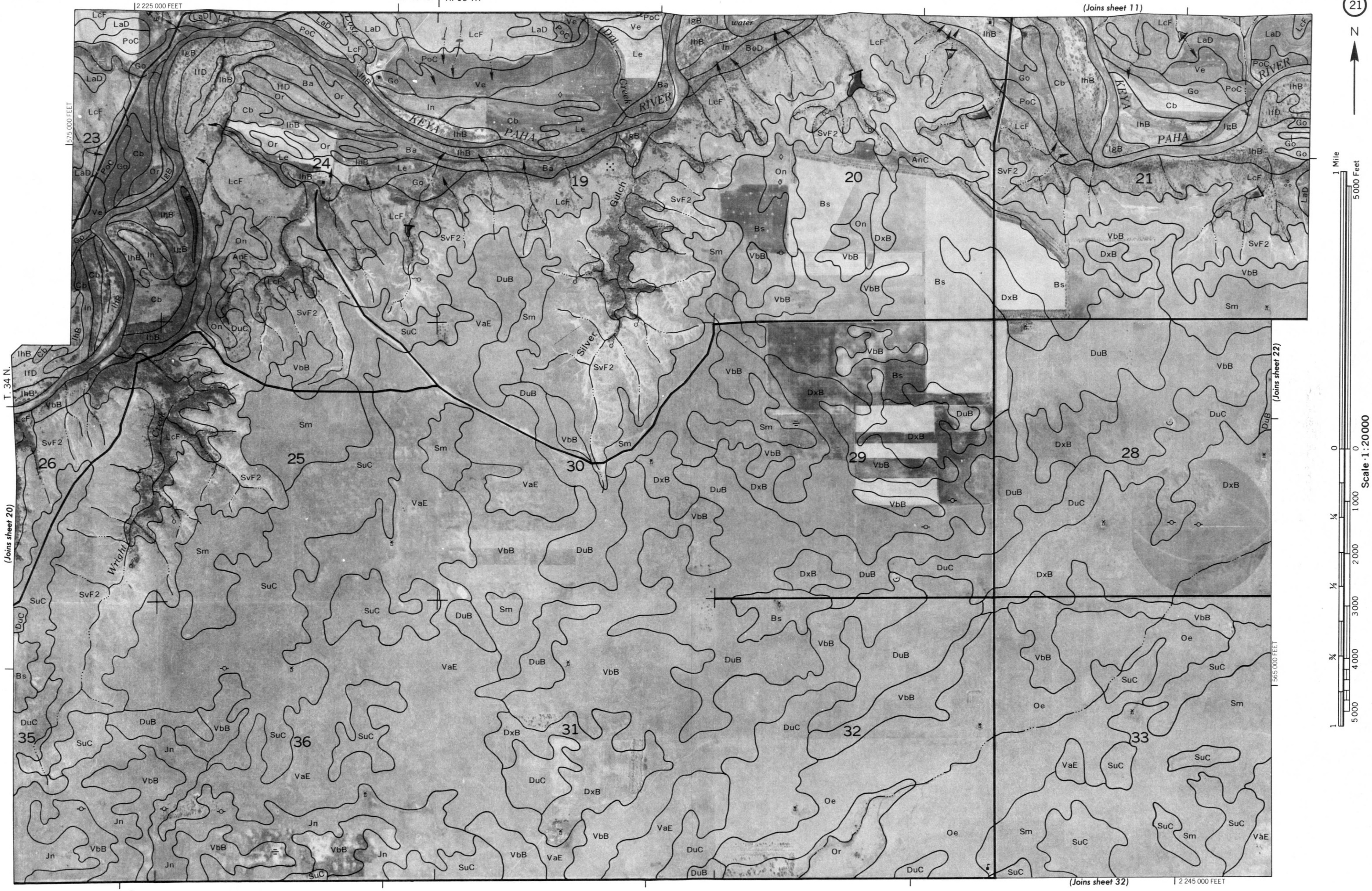

BOYD COUNTY, NEBRASKA NO. 21

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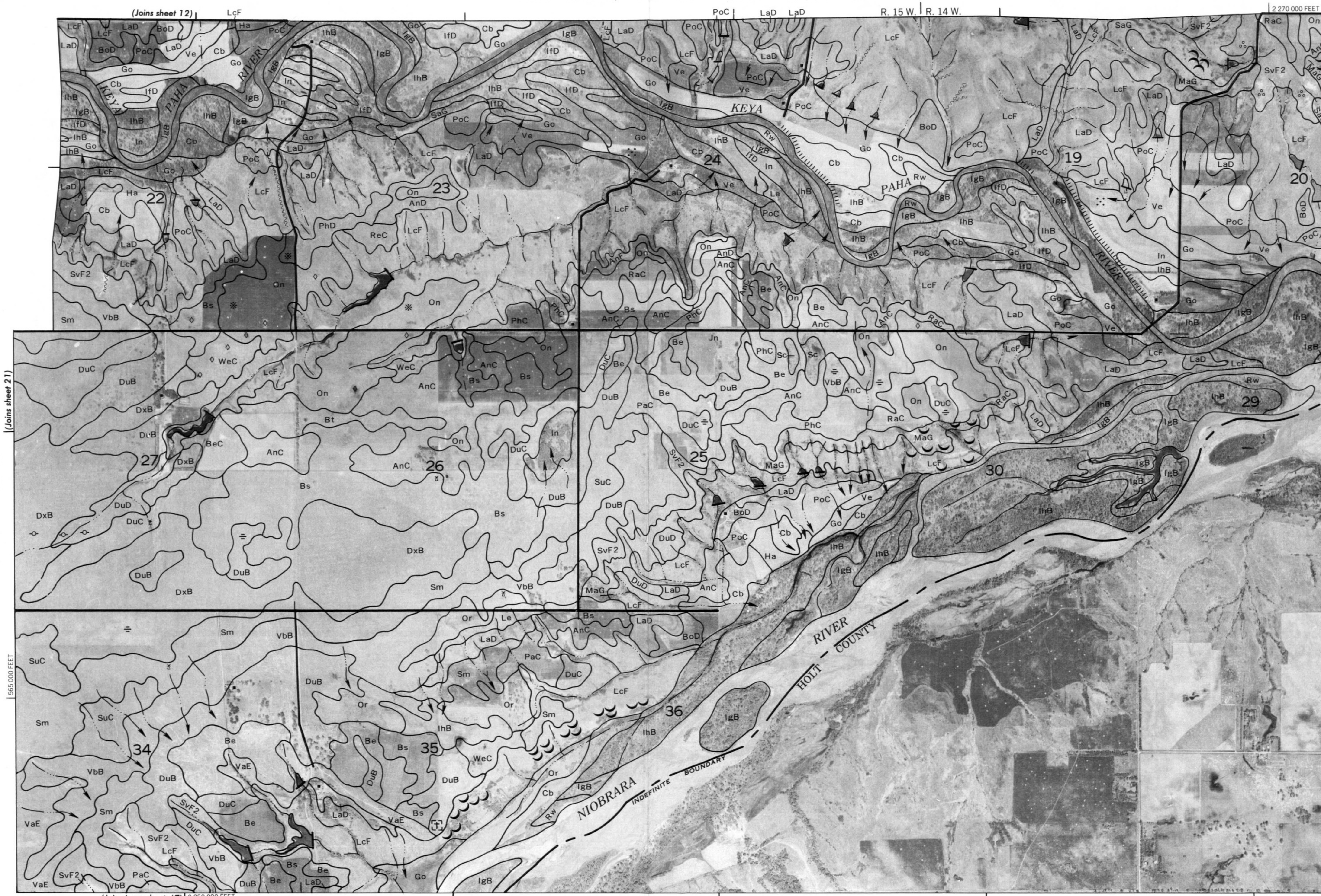
22

N

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



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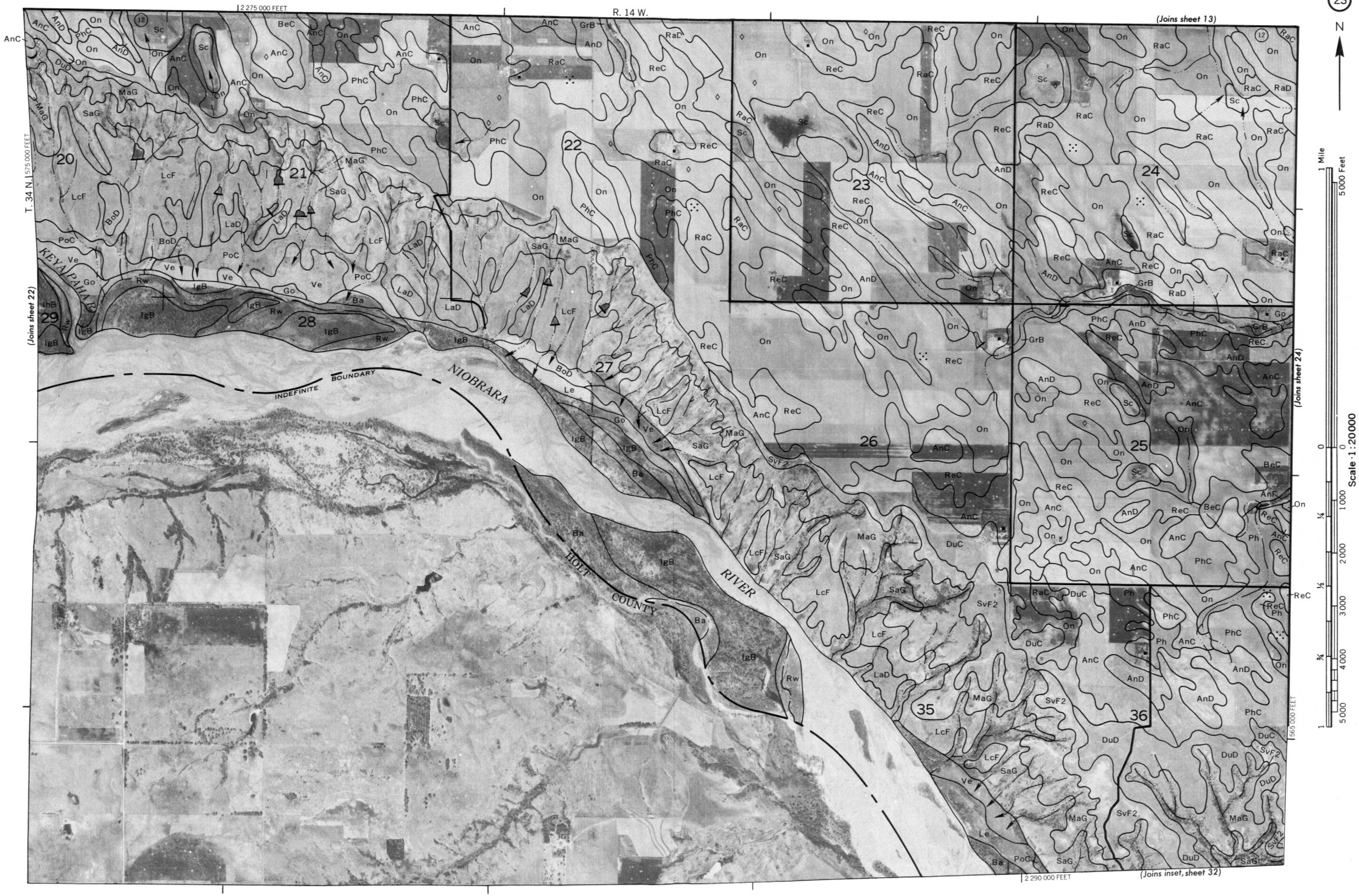

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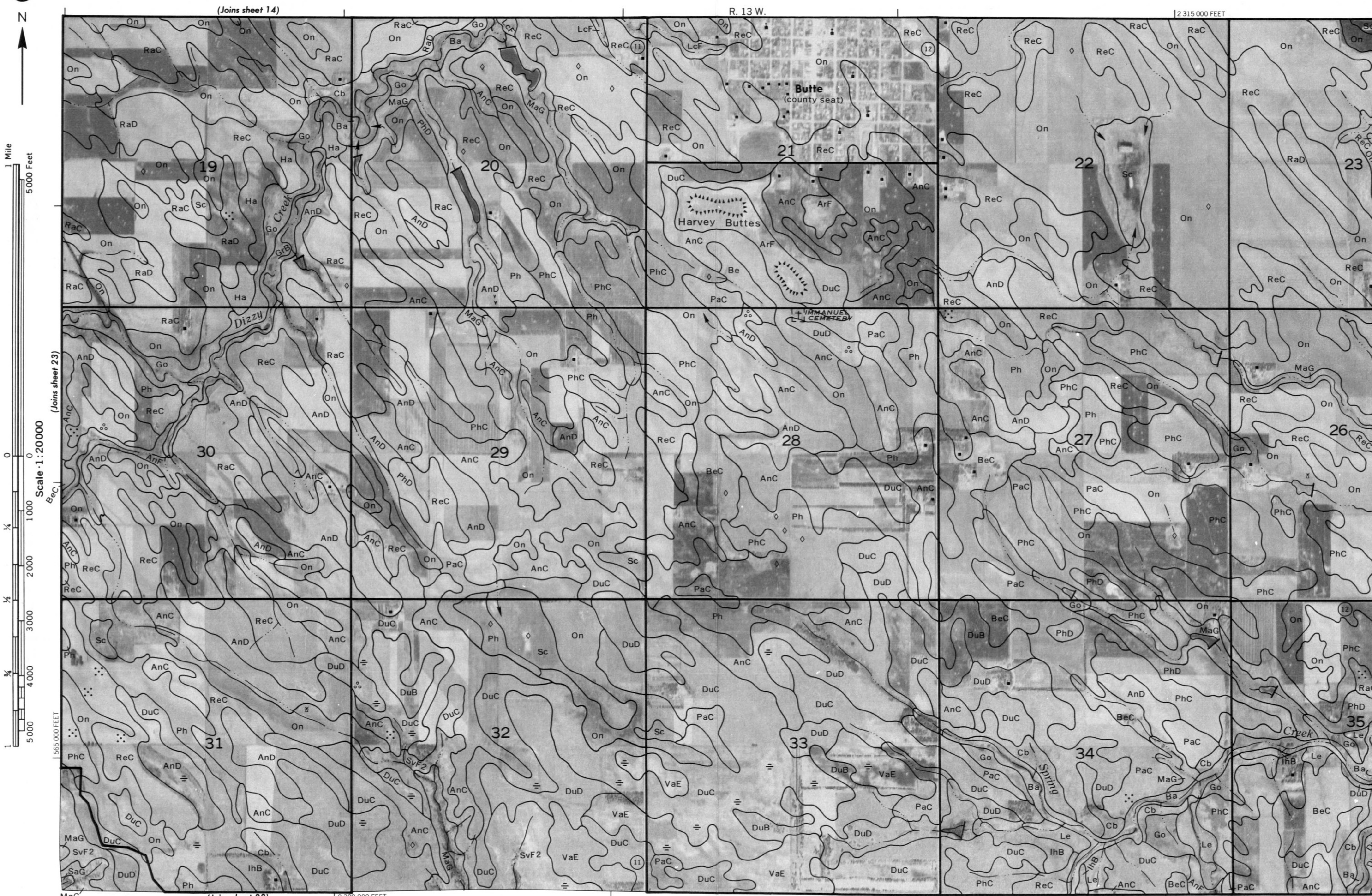
24



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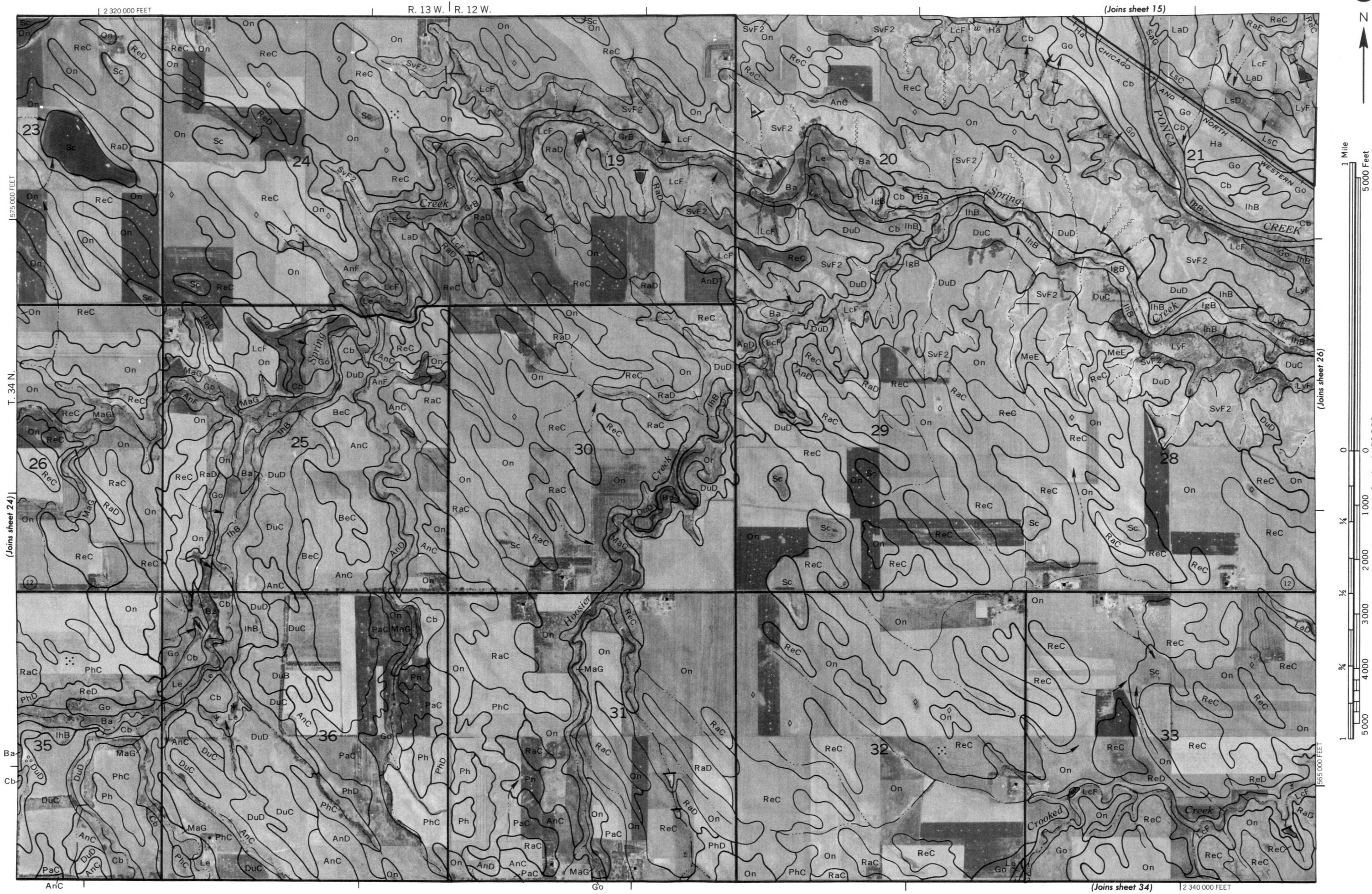

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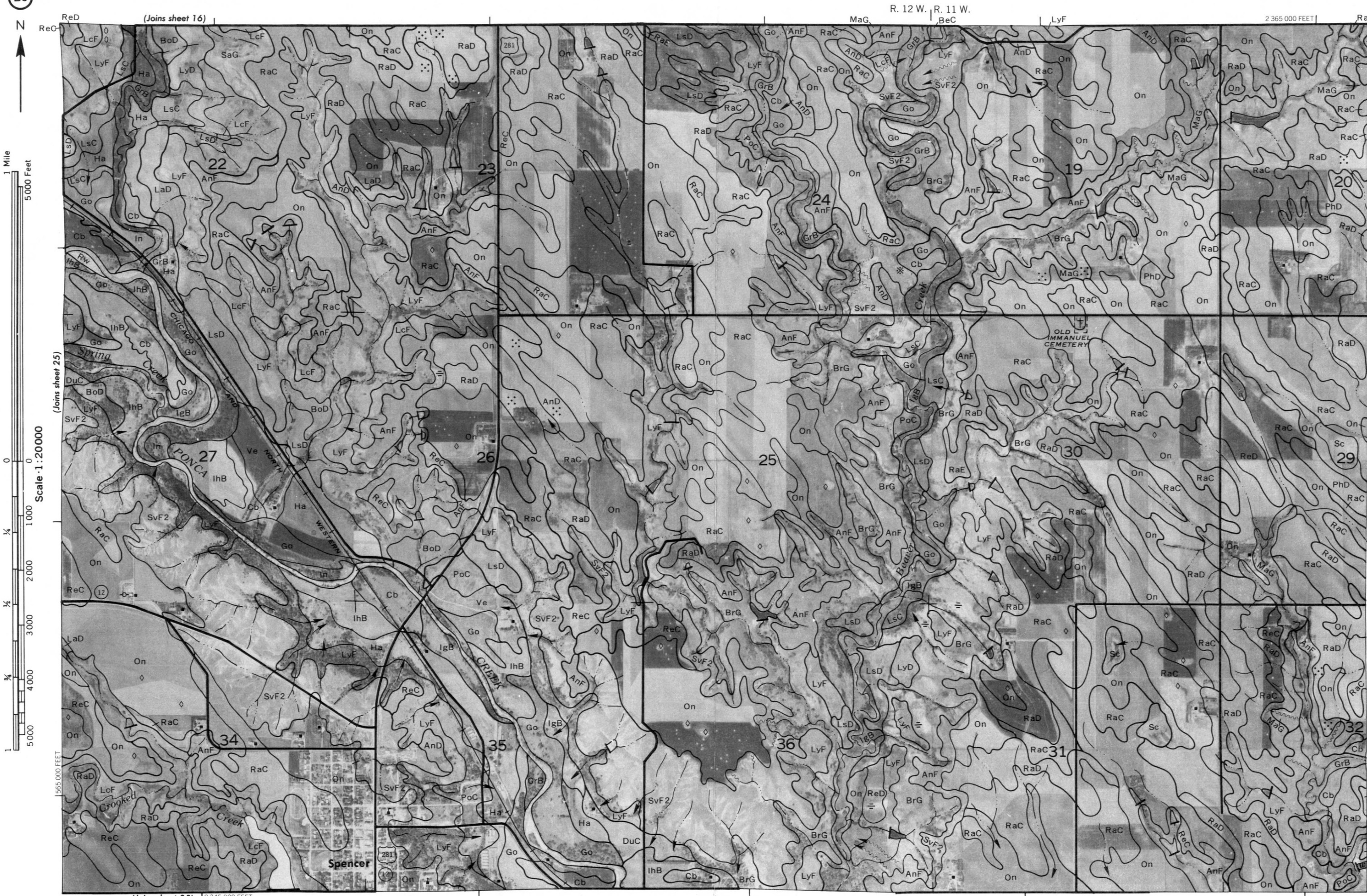
BOYD COUNTY, NEBRASKA NO. 25



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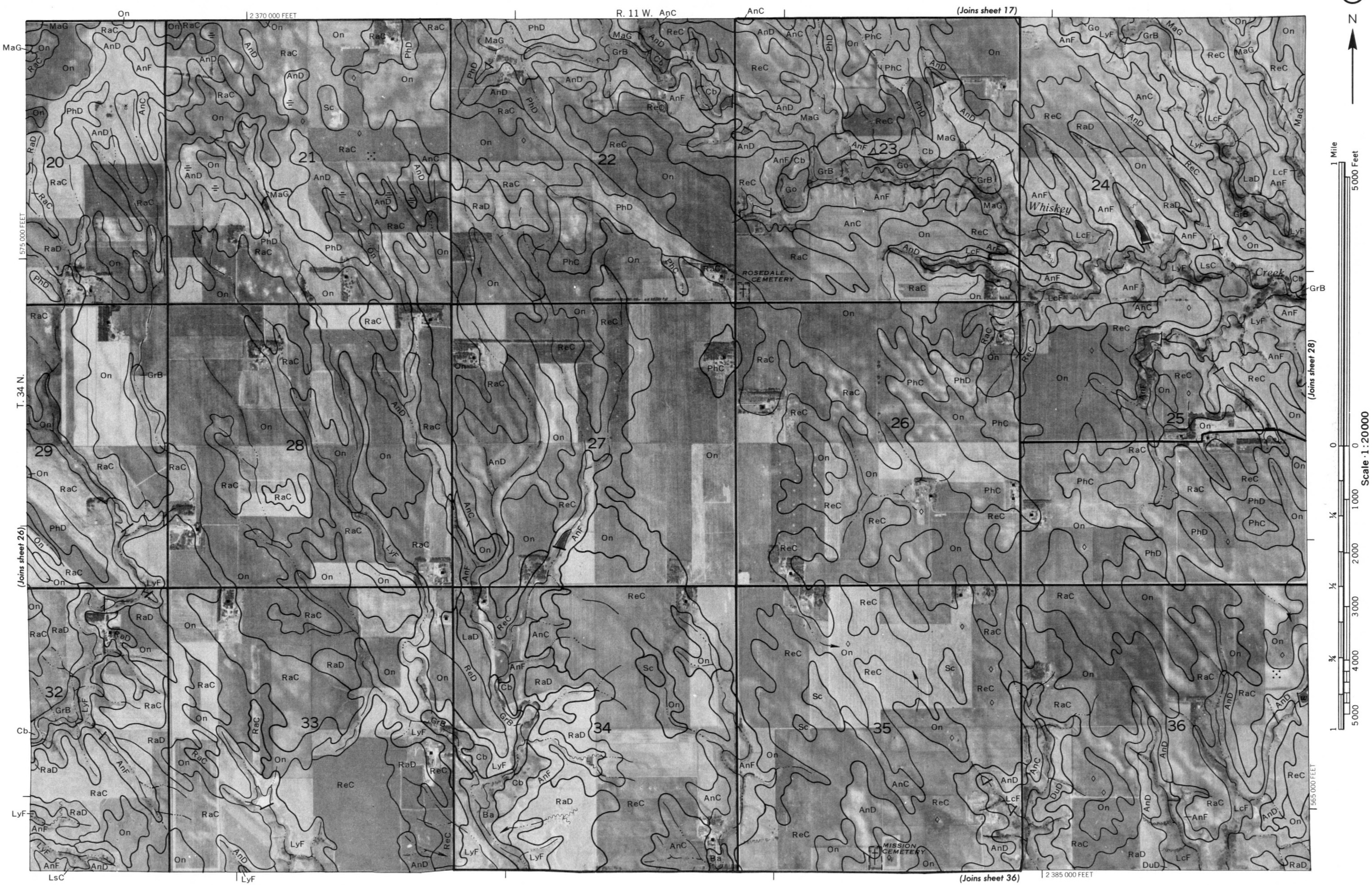

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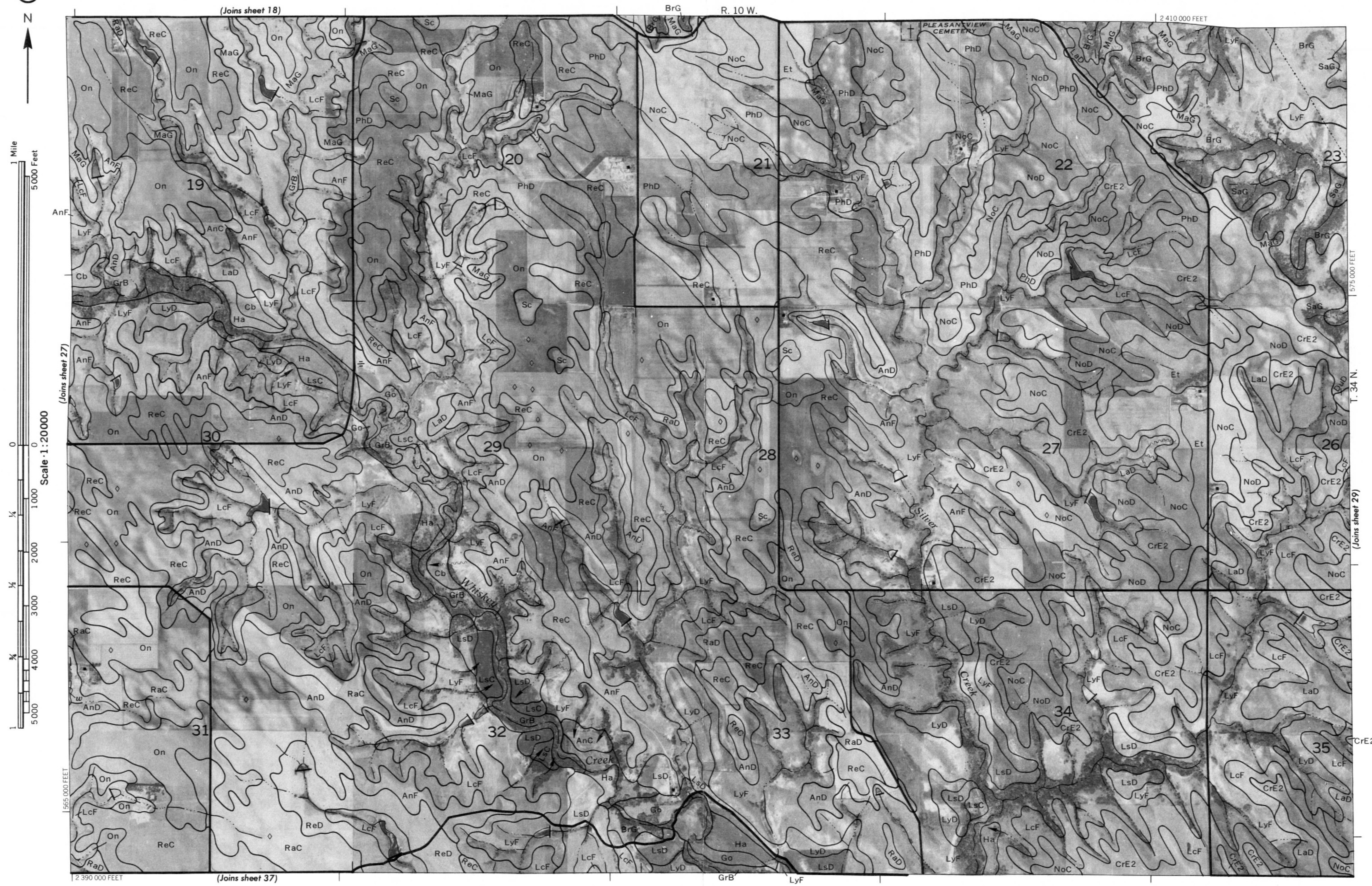
BOYD COUNTY, NEBRASKA NO. 27

BOYD COUNTY, NEBRASKA — SHEET NUMBER 28



BOYD COUNTY, NEBRASKA NO. 28

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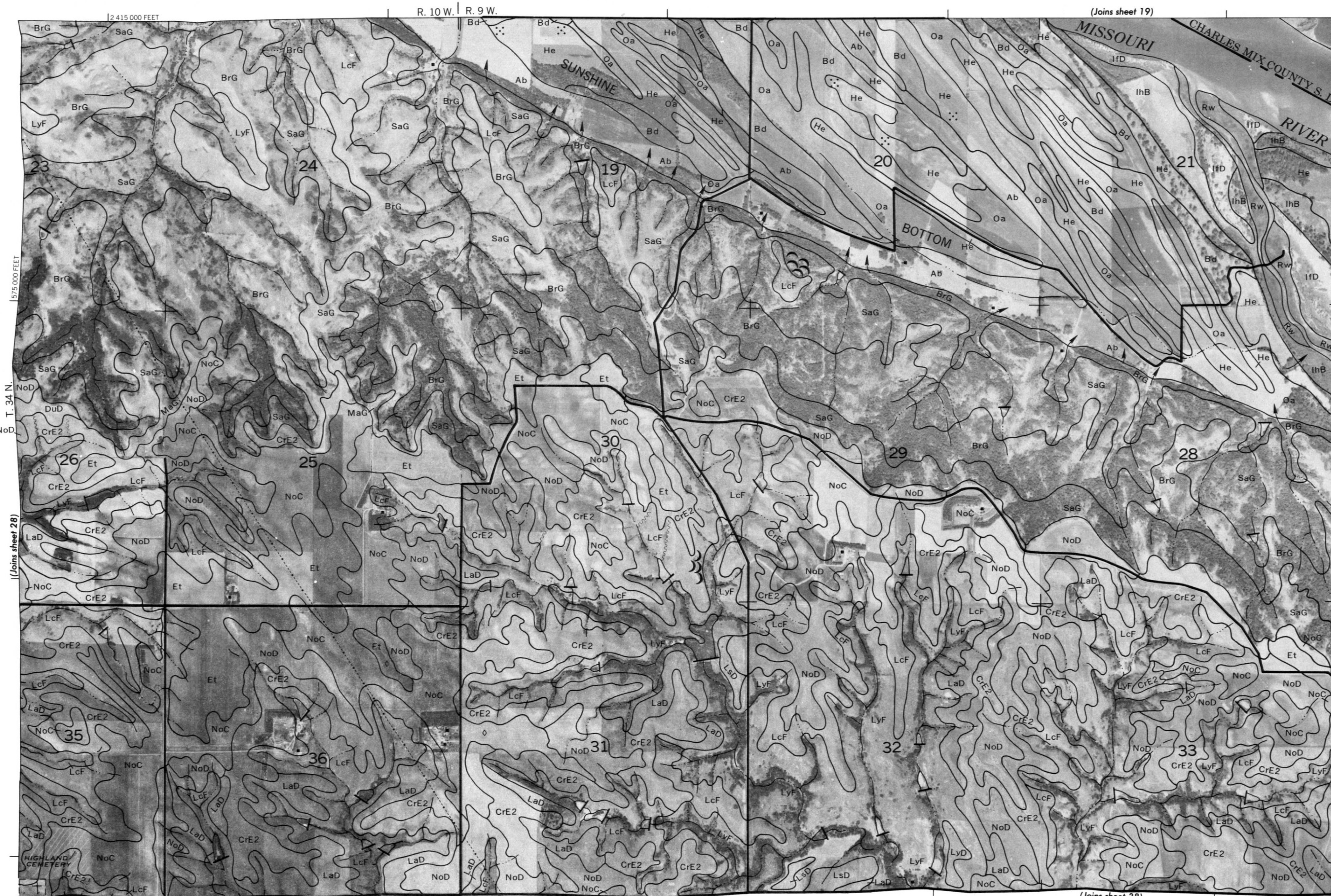
BOYD COUNTY, NEBRASKA NO. 29



N

Scale 1:20000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

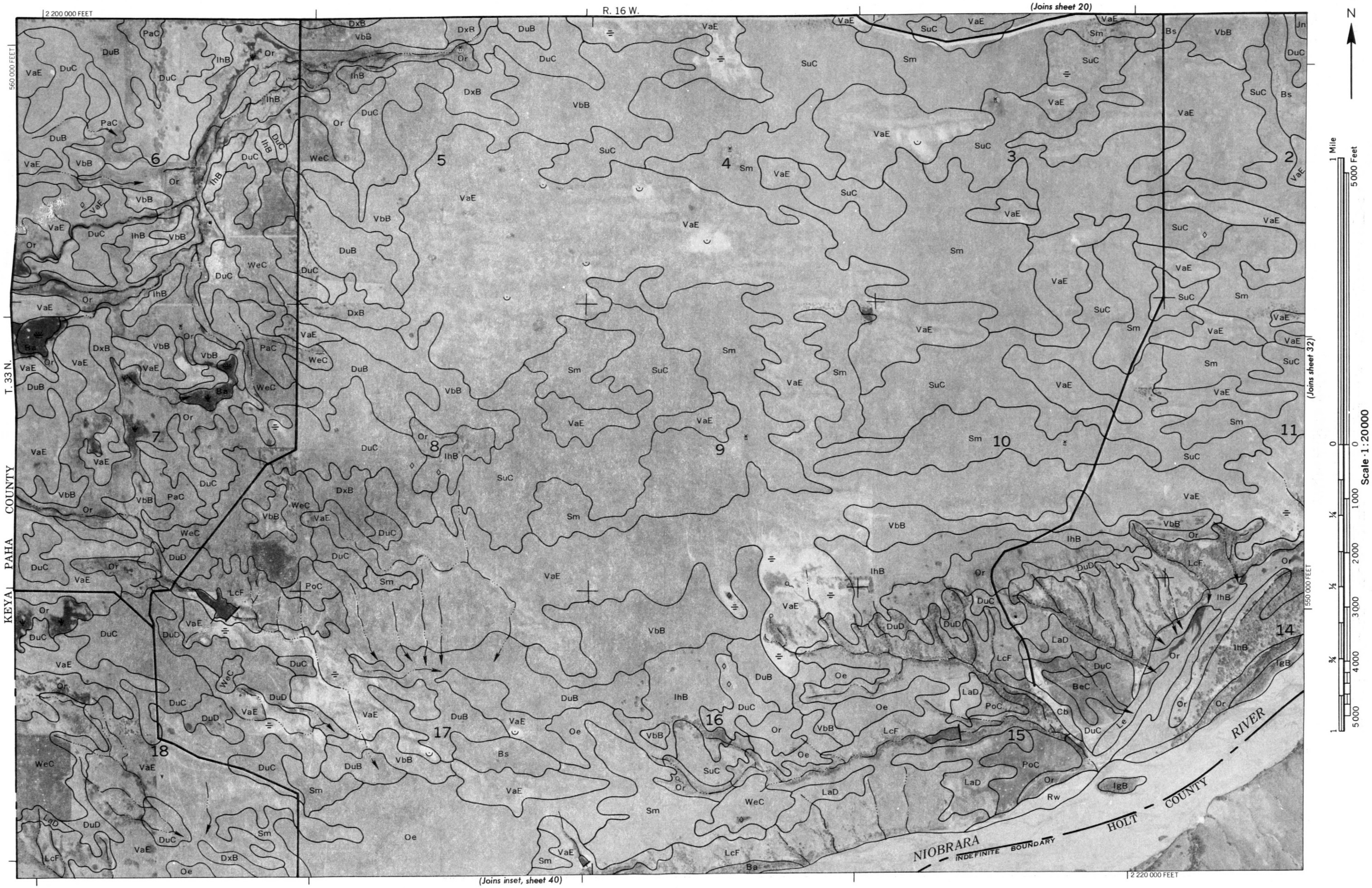
0 1000 2000 3000 4000 5000

N

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

BOYD COUNTY, NEBRASKA NO. 30

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

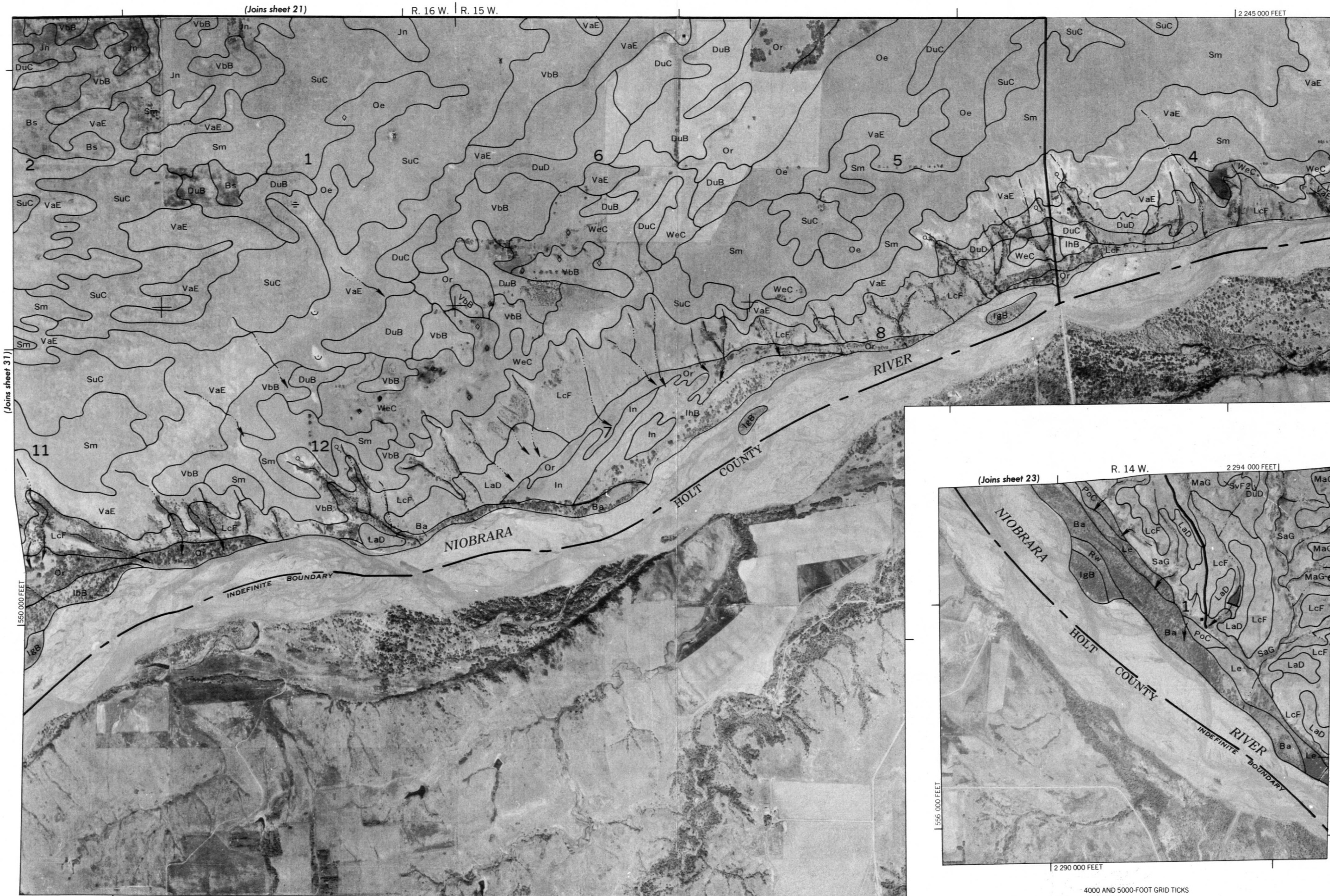


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

BOYD COUNTY, NEBRASKA NO. 31

N

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000



4000 AND 5000-FOOT GRID TICKS

BOYD COUNTY, NEBRASKA NO. 32

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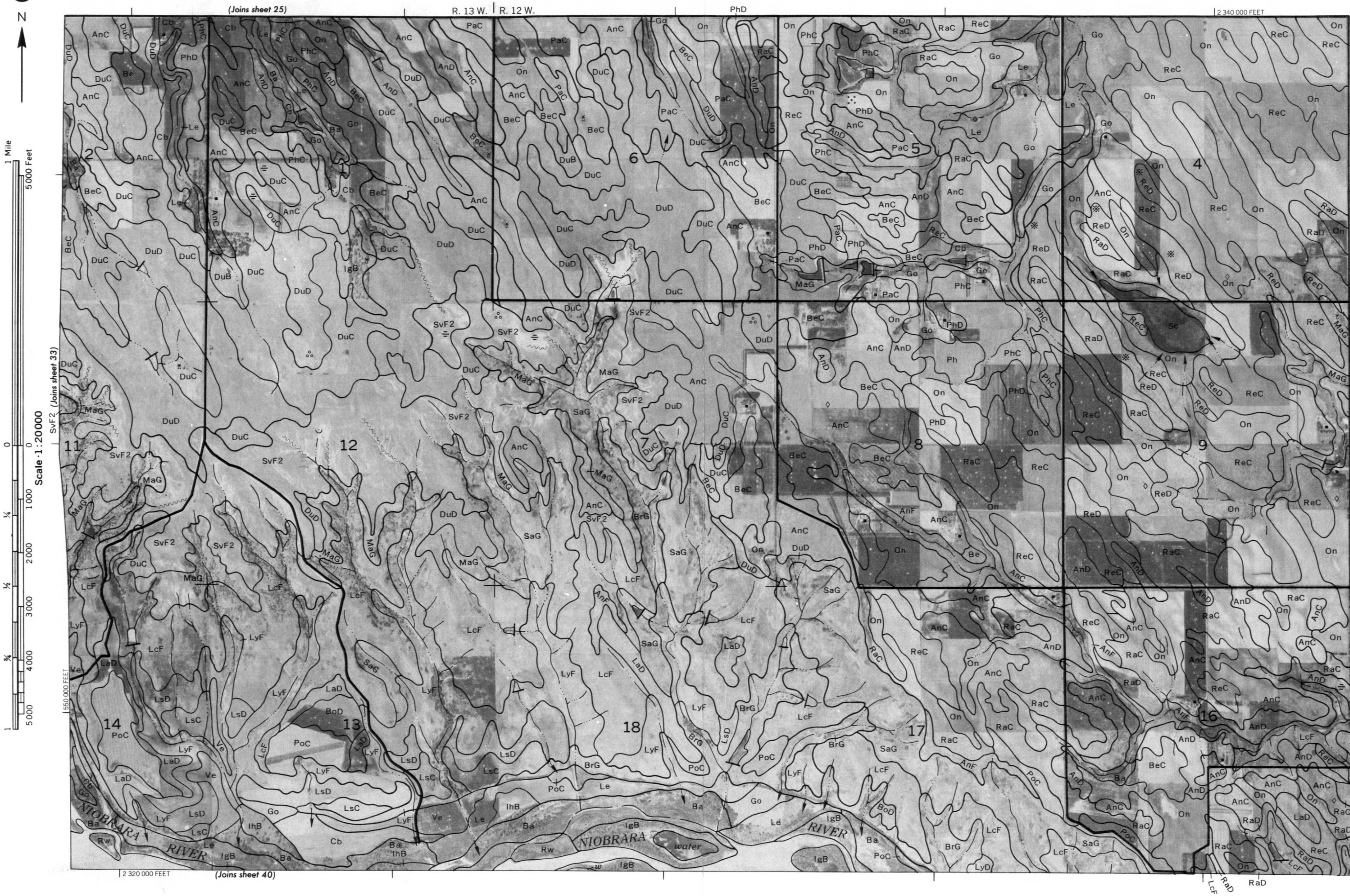
BOYD COUNTY, NEBRASKA NO. 33

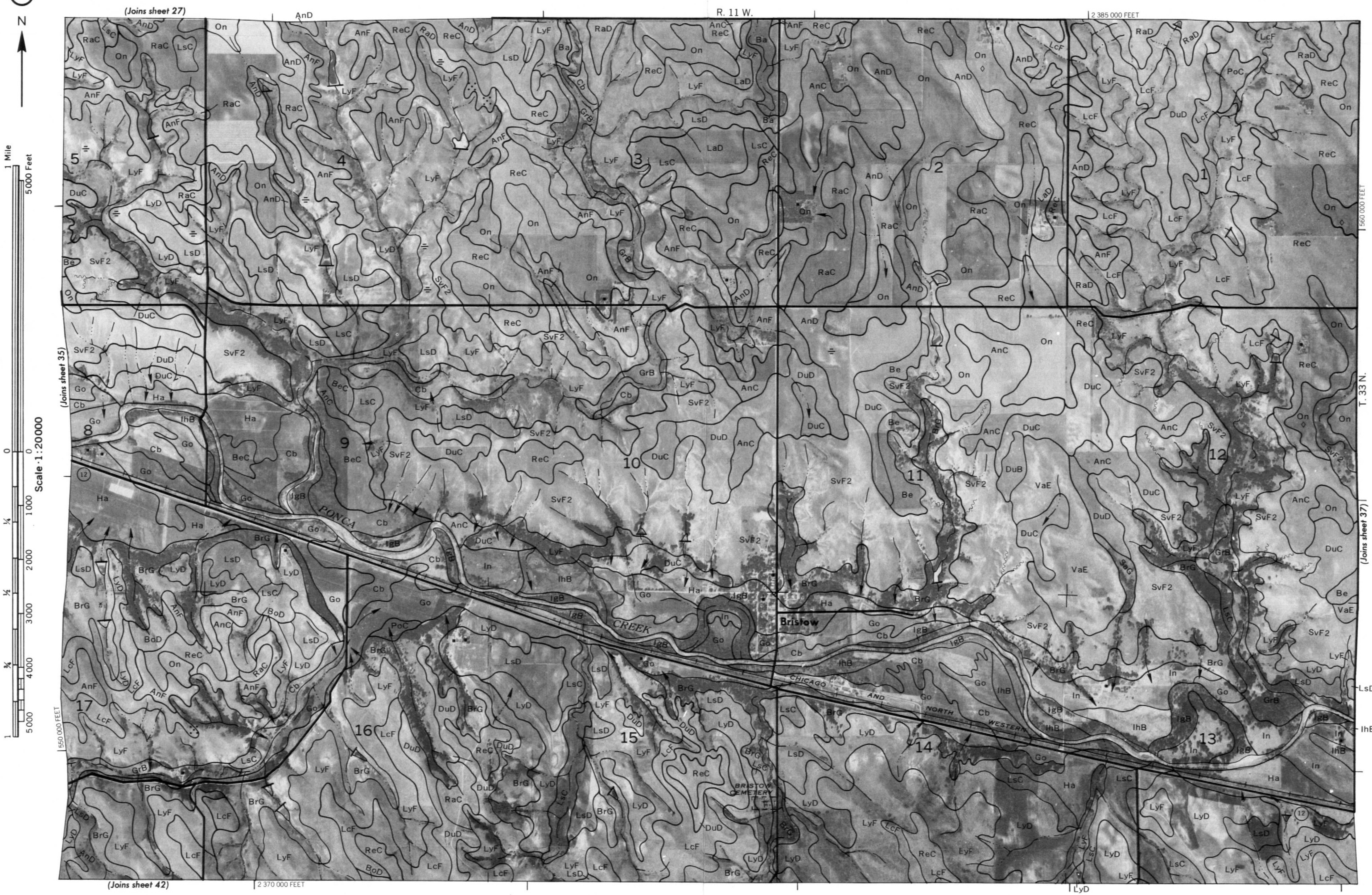


BOYD COUNTY, NEBRASKA NO. 34

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

BOYD COUNTY, NEBRASKA NO. 35

This map is compiled on 1973 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

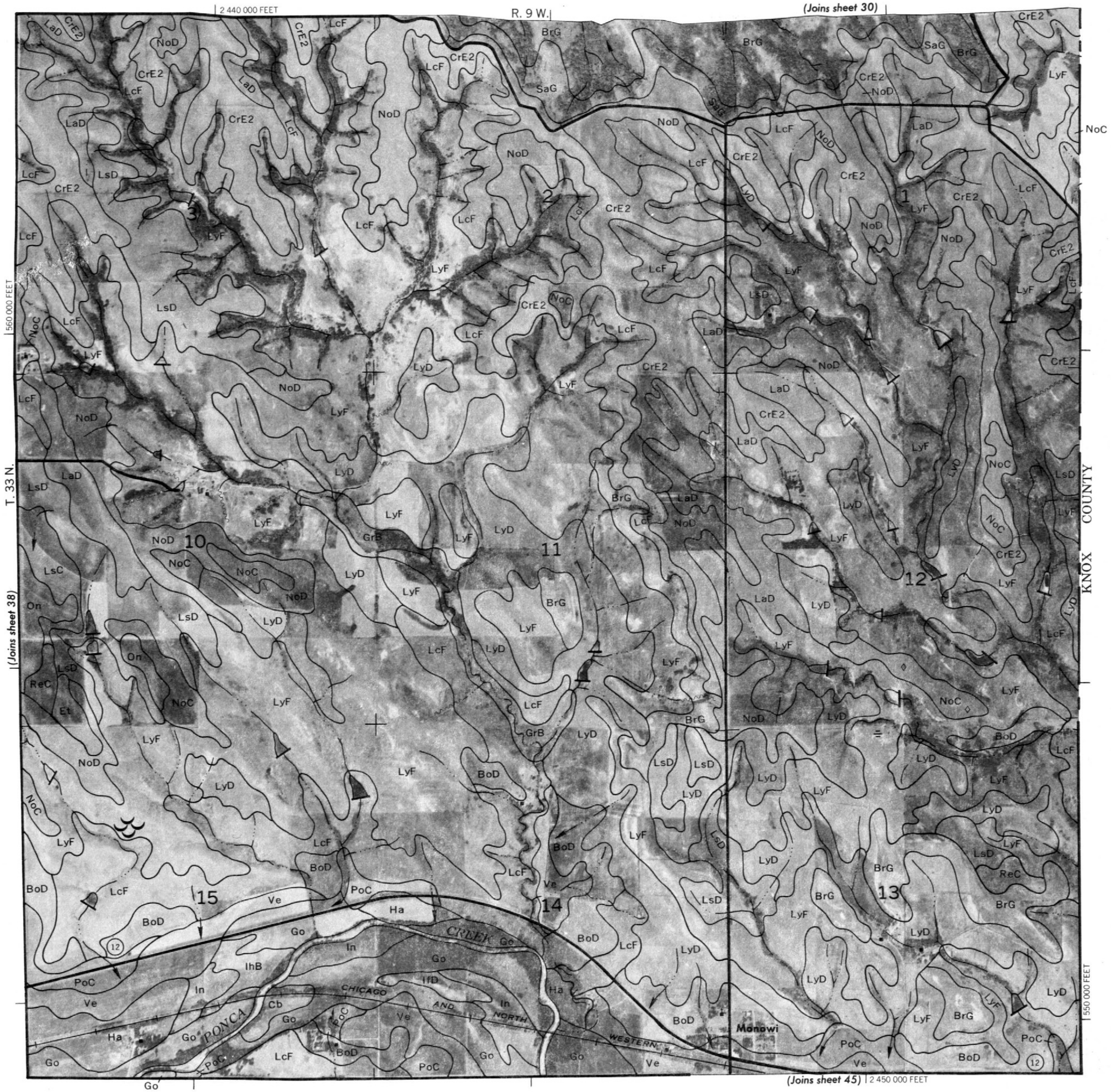


BOYD COUNTY, NEBRASKA NO. 36

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

39

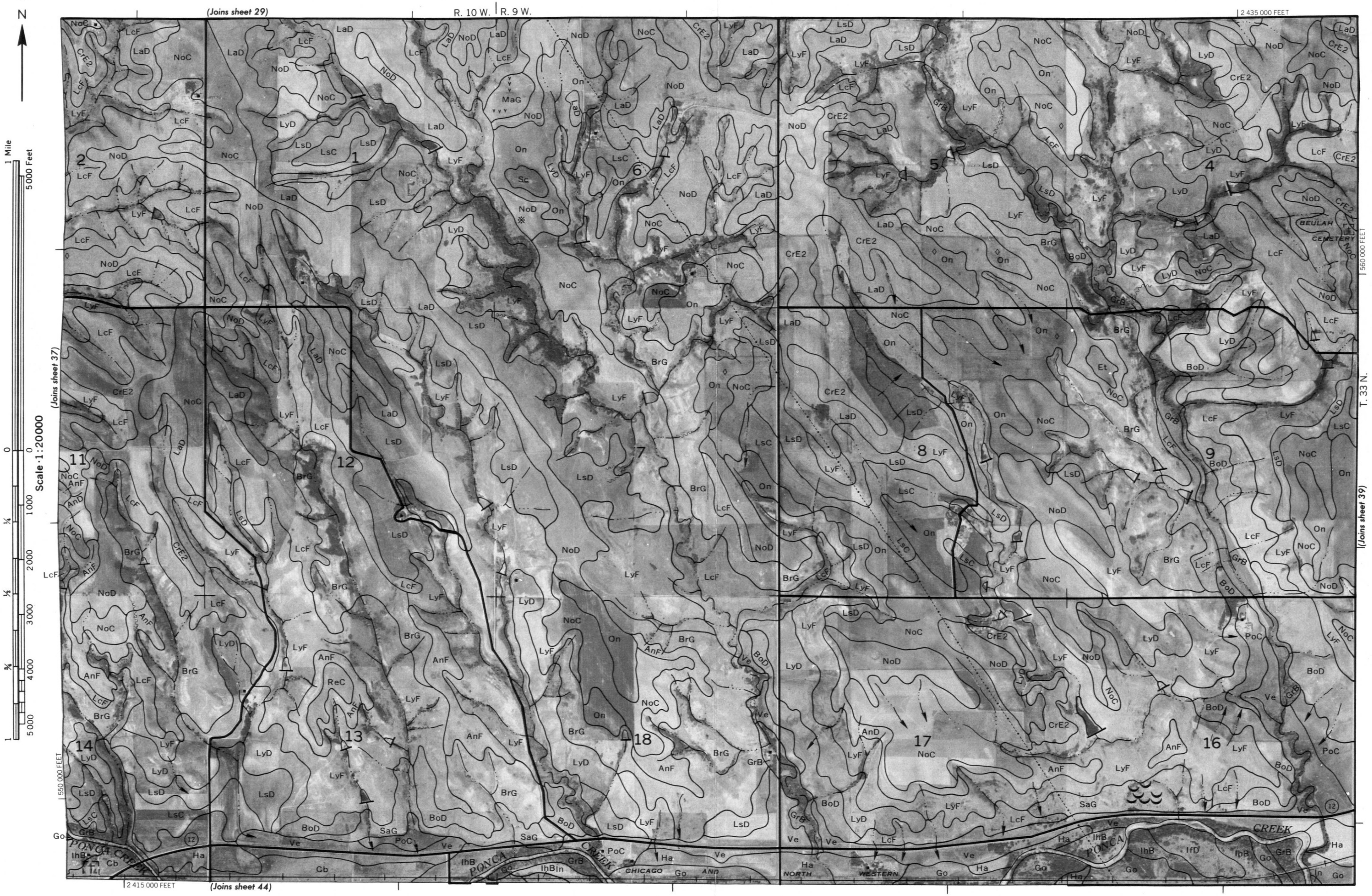
N



1 Mile
5000 Feet
0
¼
½
¾
1
Scale 1:20000
0
1000
2000
3000
4000
5000

BOYD COUNTY, NEBRASKA NO. 39

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



BOYD COUNTY, NEBRASKA NO. 38

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

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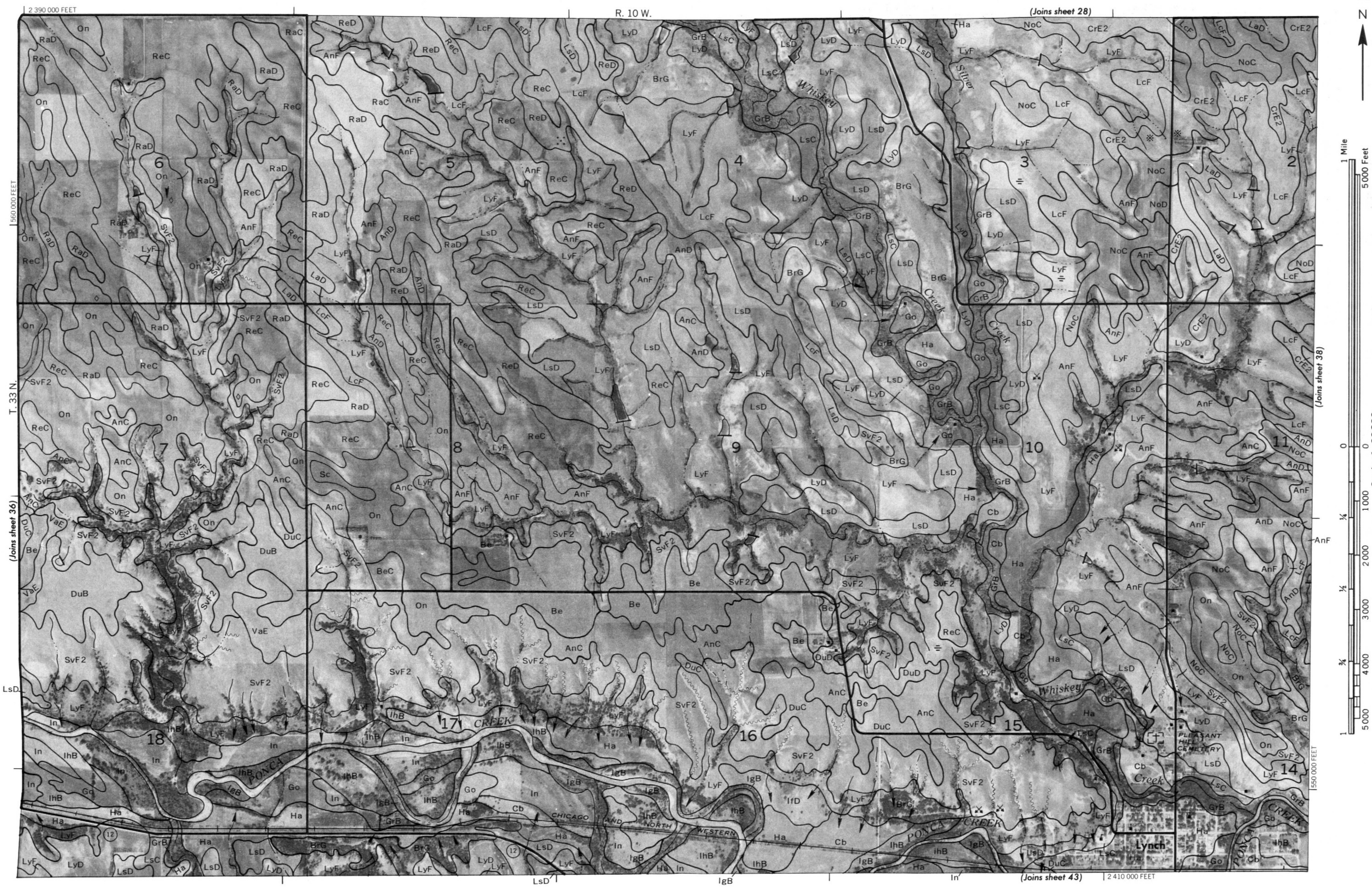
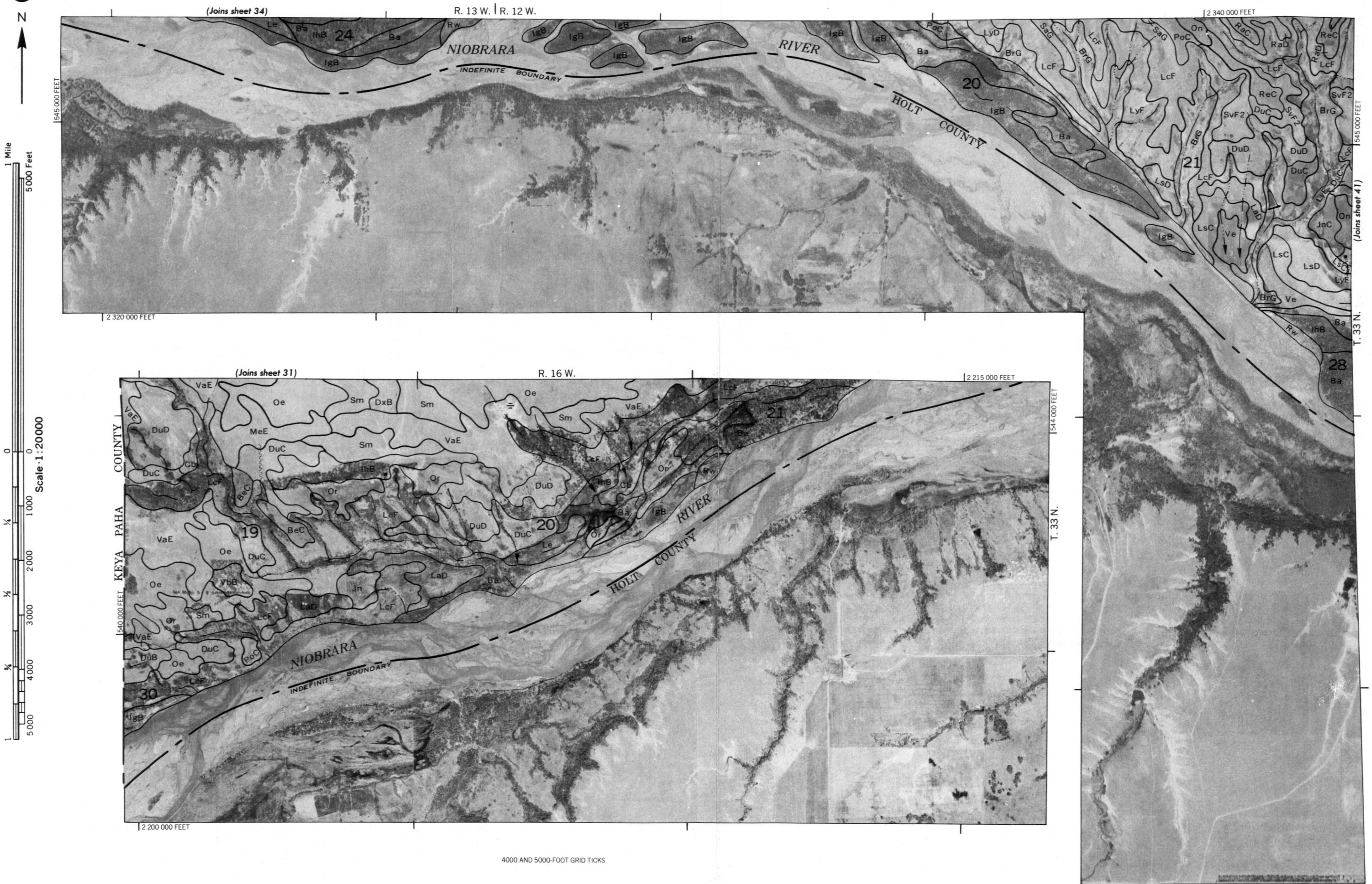
BOYD COUNTY, NEBRASKA NO. 37





4000 AND 5000-FOOT GRID TICKS

BOYD COUNTY, NEBRASKA NO. 40

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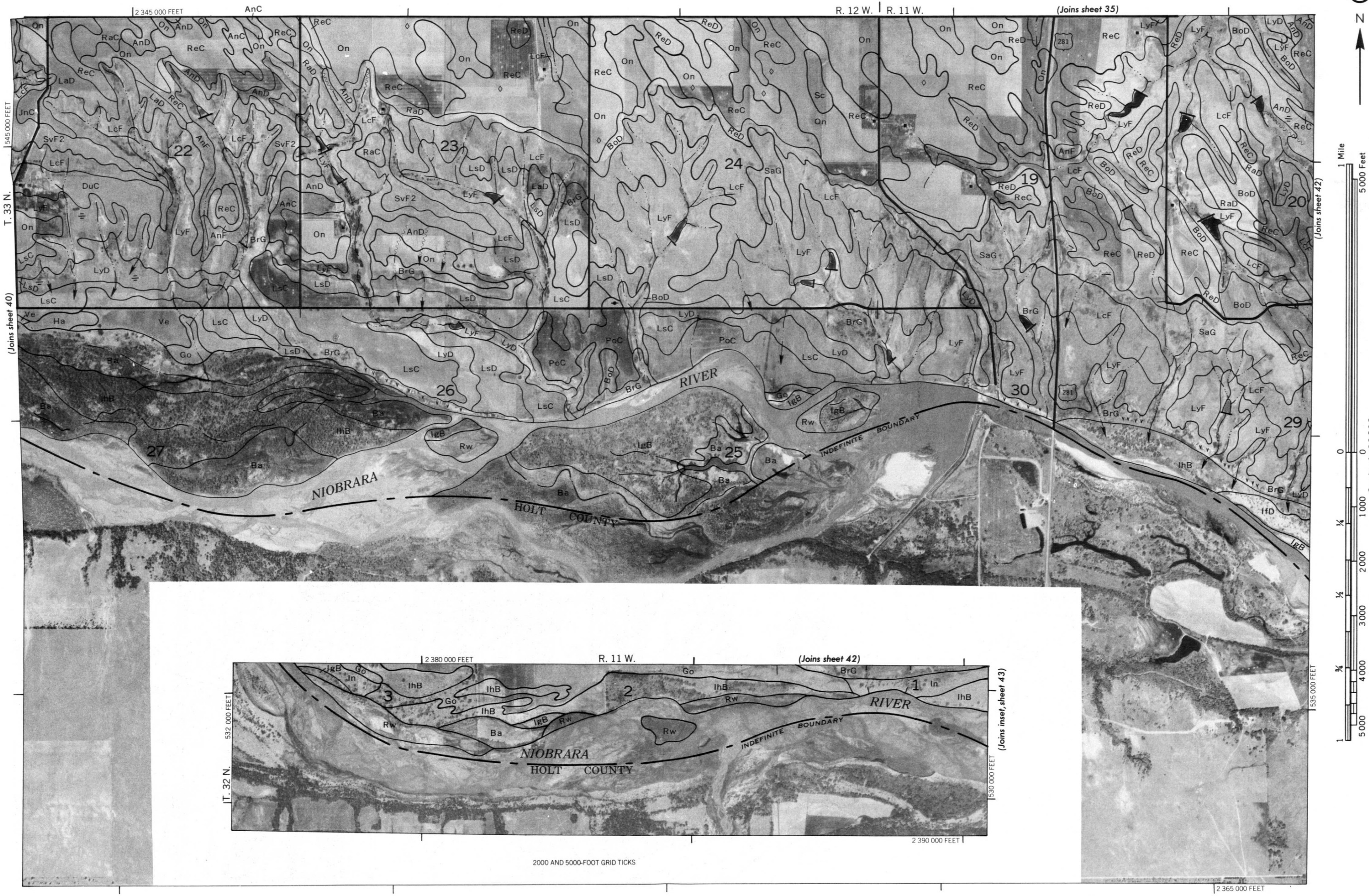
BOYD COUNTY, NEBRASKA NO. 41



42

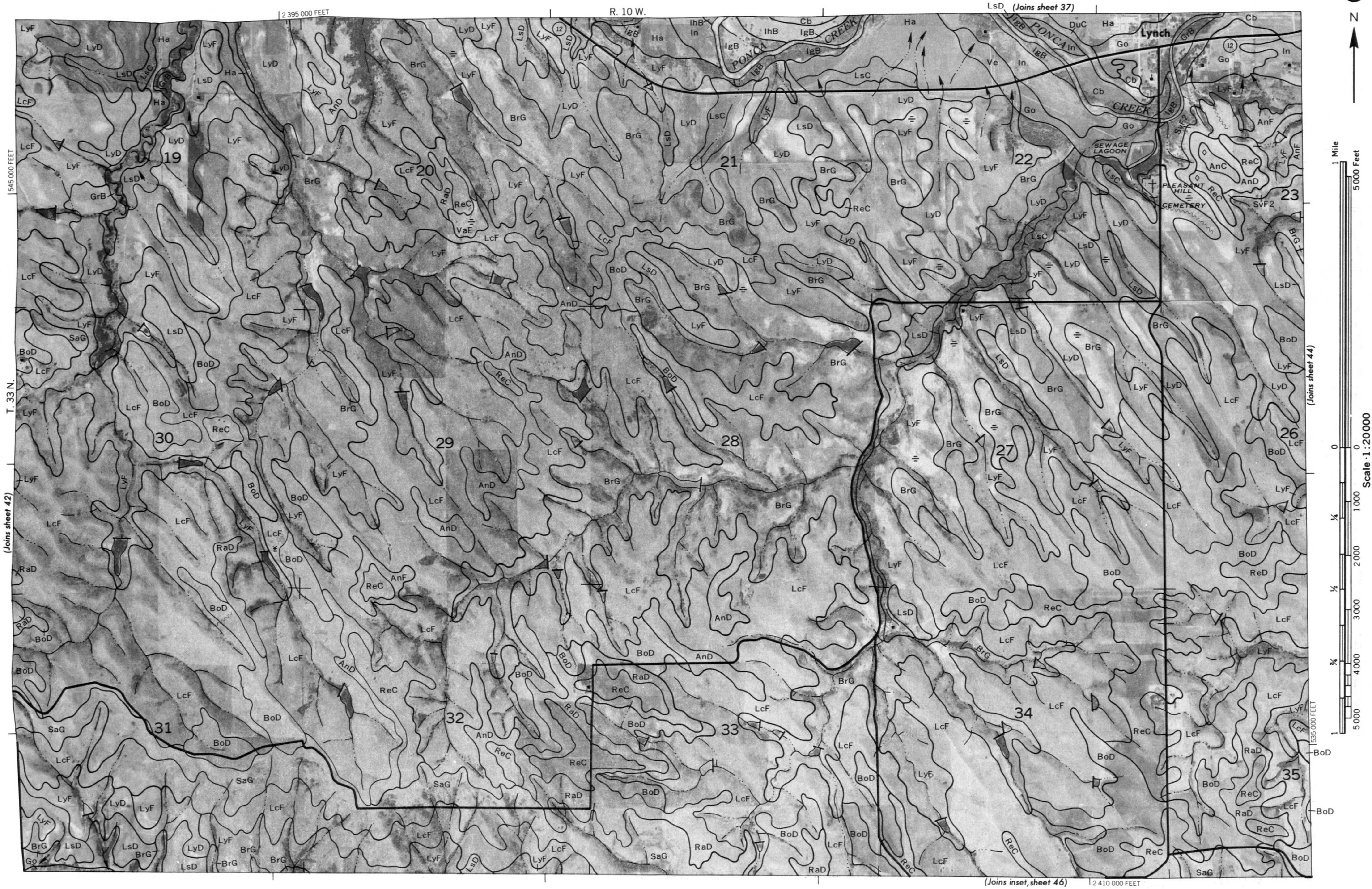
N

Scale 1:20000

BOYD COUNTY, NEBRASKA NO. 42

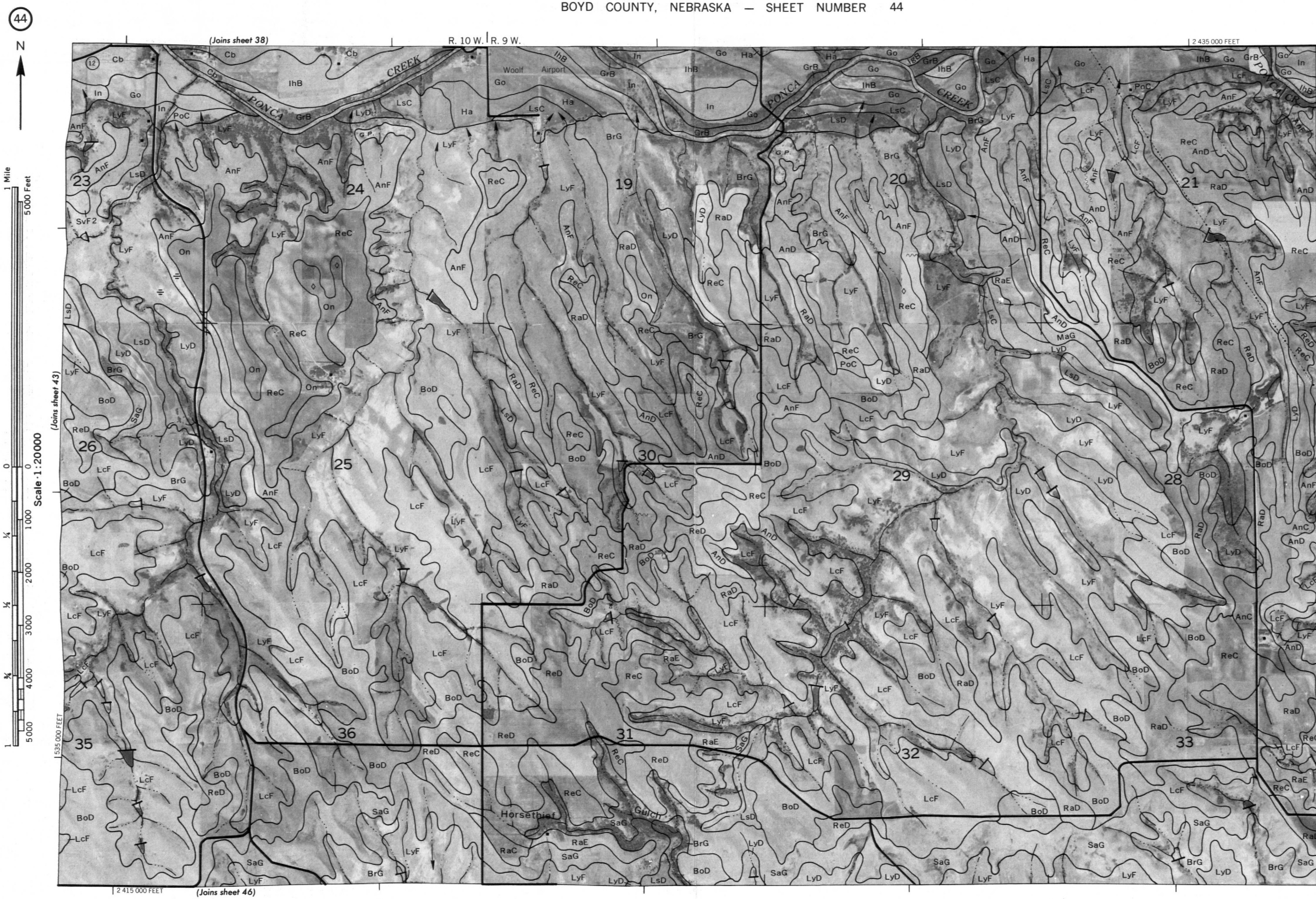
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

43



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

BOYD COUNTY, NEBRASKA NO. 43

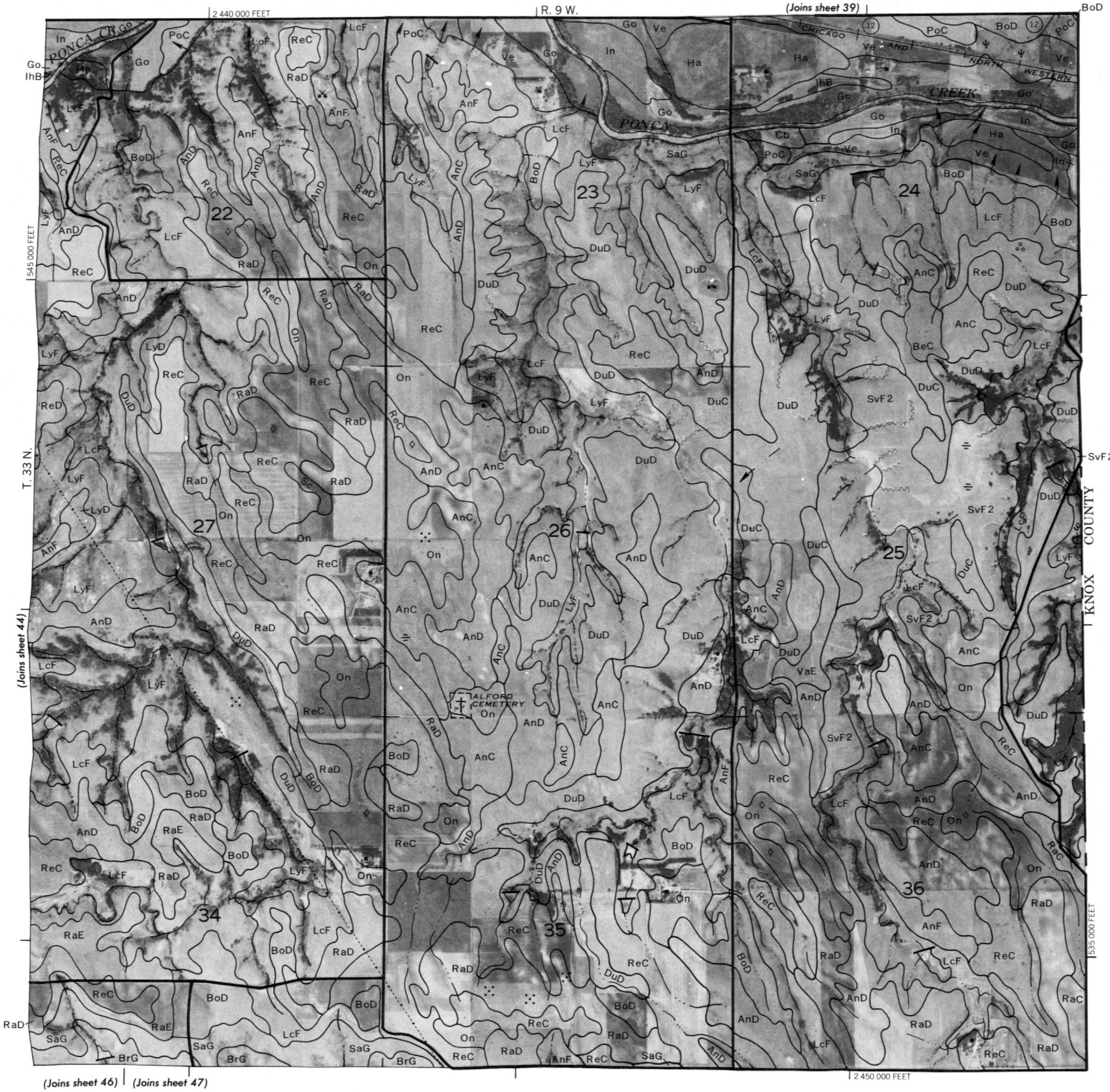


BOYD COUNTY, NEBRASKA NO. 44

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

45

N



BOYD COUNTY, NEBRASKA NO. 45

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

Scale 1:20000

1 Mile ¾ ½ ¼ 0

5000 Feet 4000 3000 2000 1000 0

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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

BOYD COUNTY, NEBRASKA NO. 47